NATURE

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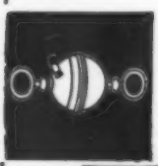

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Aeronautical Research in Australia

EARLY in 1937 the Australian Government invited Mr. H. E. Wimperis to advise on the inauguration of aeronautical research in the Australian Commonwealth. It could have made no better choice. Mr. Wimperis has been closely connected with aeronautical research practically from its beginnings in Great Britain. For twelve years until he retired in 1937 he was responsible, as director of scientific research, for the organization and development of research in the Air Ministry. Owing to his retirement he was free to apply his unrivalled experience to the problems of Australia. He spent six months in visiting the Royal Australian Air Force Stations in New South Wales, Victoria, and Western Australia, and the civil aerodromes in New South Wales, Victoria, Western Australia and Brisbane. He also visited the Munitions Supply Establishment at Maribyrnong, Victoria, and many engineering and industrial plants.

One of the principal recommendations made by Mr. Wimperis in his report* is that an engineering research establishment be organized for experimental work in aerodynamics, aircraft and automobile engines, and for the testing and development of aircraft instruments and other equipment. Mr. Wimperis estimates the initial capital cost of such an establishment to be £143,000, and the annual cost of its staff when completed to be of the order of £12,000 a year.

This recommendation has already been acted upon, and a start has been made in the building of the laboratory at Fishermen's Bend, a few miles from Melbourne. The laboratory is to be built close by the aerodrome belonging to the independent Commonwealth Aircraft Corporation, which has agreed to give free use of its aerodrome to the laboratory and to co-operate fully with the research investigations. A short distance away are the works of the General Motors Company.

It is understood that the Commonwealth Government also intends to set up a Bureau of Standards at Sydney. The new Engineering Research Laboratory at Fishermen's Bend and the Bureau of Standards at Sydney will correspond together to the National Physical Laboratory in England. The aeronautical work at the new laboratory will be supervised by an Australian Aeronautical Research Committee; but the laboratory as a whole will be administered by the Council for Scientific and Industrial Research, the chief executive officer of which is Sir David Rivett.

Mr. Wimperis also recommends the establishment of a professorship of aeronautical engineering, and a readership in meteorology in Australian universities. Both these recommendations have already been given effect. A chair of aeronautical engineering has been established at the University of Sydney. The Commonwealth Government has made a grant of £20,000 for the building of an aerodynamics laboratory at the University, £12,000 for its equipment, and £3,000 a year for salaries and maintenance. The State Government has added £18,000 for building a hydrodynamics laboratory in conjunction with the aerodynamics laboratory. An assistant professorship of meteorology has been established at the University of Melbourne.

It may possibly be argued that the comparative remoteness of Australia, even in these days of rapid transport, the smallness of its population, and the relatively insignificant size of its industry, all combine to make the carrying out of aeronautical research both expensive and unnecessary, in view of the very large sums of money already

* Parliament of the Commonwealth of Australia. Report by H. E. Wimperis on the Inauguration of Aeronautical Research in Australia, dated 21st December 1937. Pp. 17. (Canberra: Government Printer, 1938.) 1s.

devoted to the subject in other countries in Europe and America. Would it not be possible for Australia to get all the information it needs by studying the results of work in Great Britain and in America without attempting to duplicate it on what would appear in these countries to be an inadequate scale? Such views have been expressed, but we believe them to be entirely wrong. In the first place, no one can appreciate fully and apply the results of scientific investigations unless they themselves are engaged on similar work. It does not matter in the least that Australia may not be in a position for many years to contribute anything of first-class importance to the science of aeronautics. If no start is made, there never will be such contributions. Now that the start has been made, Australian contributions to the science will depend upon whether men of first-rate ability can be attracted to the country. In the meantime, the presence and active work of a trained staff will undoubtedly lead to a fuller comprehension and application of the results of work in other countries.

In the second place, Australia is committed to a policy of developing its manufacturing industries, as well as the older and more valuable industries of agriculture and mining. If Australia seeks, as it undoubtedly does, to attain a high state of efficiency in its manufacturing industries, it certainly needs a central institution of the first rank in engineering research. In the particular case of the aeronautical industry, it is essential for the defence of Australia, and not merely of Australia but also of the British Commonwealth of Nations, that the manufacture of aircraft on a large scale should be undertaken in Australia. A start has been made and the industry is in the hands of capable and enthusiastic leaders. That it is bound to expand, and expand very greatly, in the near future is scarcely open to doubt, and its expansion must be facilitated by the new creation of a Government Aeronautical Research Laboratory. In aeronautics, as in every other branch of applied science, research and manufacture react on each other. Neither can be fully efficient unless it is in close contact with the other. Aircraft manufacture in Australia cannot exist in a healthy state if it merely relies on information and advice from other countries; nor will Australian aeronautical research be much more than academic and second rate if it is not carried out in the closest contact and with the enthusiastic support of Australian aircraft manufacturers.

The organization starts under the happiest auspices. The Australian Council for Scientific and Industrial Research, presided over by Sir George Julius, and administered by Sir David Rivett, has the complete confidence of the Australian Government, and scientific workers in Great Britain as well as those in Australia will feel that the development of aeronautical research in that continent is in safe hands.

The Modern Approach to Indian Problems

(1) Social Service in India:
an Introduction to some Social and Economic Problems of the Indian People. Written by Six Contributors. Edited by Sir Edward Blunt. Pp. xxiii+447+16 plates. (London: H.M. Stationery Office, 1938.) 10*s*. 6*d*. net.

(2) Health and Nutrition in India
By N. Gangulee. Pp. viii+337+13 plates. (London: Faber and Faber, Ltd., 1939.) 15*s*. net.

(1) WHATEVER may have been the ideas of the founders of the British Empire, the purpose always before the best of the modern administrators is to develop each part so as to give to its inhabitants the fullest and richest life possible for them. This purpose is particularly clearly shown in the volume called, appropriately enough, "Social Service in India" published by H.M. Stationery Office, and edited by Sir Edward Blunt, with the collaboration of six colleagues, including some of the most distinguished Indian civil servants. The volume grew out of a proposal made by Sir Atul C. Chatterjee's Committee set up in 1936 to inquire into the system of probation for the Indian Civil Service: the proposal was that lectures should be given to the probationers on social welfare in India, and that a book should be prepared for use in connexion therewith. The first course was given in 1938 and the chapters were issued in typescript; they were then revised and expanded and are now printed in book form.

Contributors and editors alike have done their work well, and we know of no account of modern India so complete and concise as this. Sir Edward opens with two chapters on the environment and the people, showing, in the manner of the modern

geographer, how each has reacted on the other. Then follows a chapter by Mr. C. G. Cherevix-Trench on the rural community, giving a clear statement of its complex structure, of the *ryotwari* and the *zemindari* systems of land tenure and management, and of the land revenue and settlement problems.

Mr. R. G. Allan contributes two chapters on agriculture, the first giving a well-balanced account of the actual position, and the second showing the steps which the various departments are taking to effect improvements. These include the provision of better seed, better manures and implements, better methods of cultivation and of water supply, better livestock and better marketing facilities. There is also a section on the cultivation of fruit and vegetables, now recognized as of growing importance as sources of vitamins and mineral substances in the people's dietary. Cattle are of particular significance in the life of the village: usually the males are favoured as supplying power to the farmer, while the females have a less important position, receiving less food and of poorer quality, excepting only when they have special value for milk production. Broadly speaking, the poorest types are found in the areas around the head of the Bay of Bengal—regions of high rainfall and lateritic soils; the better types are found in the drier tracts of the Central Provinces, Bombay and northern India. Mr. Allan accepts the necessity for burning the farmyard manure, this being a cheaper fuel than coal or charcoal: but the peasant is being made to realize that green manures, composts and earth soaked with the urine of animals, are all good manures. Green manuring is found to be the most practicable, and it is now most common (1) before sugar-cane, where the ground was formerly left as open fallow, (2) before irrigated wheat, (3) before rice, if rain or irrigation permit of the establishment of a leguminous crop before transplanting begins. Night soil is but little used, as only very low castes will handle it.

Closely associated with agriculture come public health and nutrition, ably dealt with by Sir John Megaw. Famine and pestilence have in the past taken a terrific toll of Indian life: Sir John shows how they were gradually controlled, and describes in some detail the public health services of the Central Government and of the Provincial Governments. Systematic efforts are made in some provinces to bring medical aid within reach of every village. In Madras, 428 medical men receive a subsidy on condition that they reside in certain villages and provide medical relief for the sick poor. In the Punjab, 360 small dispensaries have been built, each in charge of a subsidized practitioner—these are in addition to the older hospitals and dispensaries. Some £3,000,000 has been spent on hospitals in British India, and nearly 12,000 students are being trained in the medical schools and colleges. There are, however, nearly half a million villages in British India alone, exclusive of Burma and the Indian States, and they contain nearly 90 per cent of the total population of 270 millions. The birth-rate in British India is high; in 1935 it was 35 per mille (this included Burma) against 15 in England: the death-rate was 24 against 12 in England: the infant mortality-rate was 154 against 57 in England. The most significant fact brought out by these figures is that the annual number of births in British India and Burma averaged 4½ millions between 1881 and 1890, but was more than 9½ millions in 1935. This great growth of population is, of course, putting considerable pressure on the land, and Sir John recognizes that human nutrition is the most important and most difficult of all Indian problems. Experts differ as to whether the total food production in India is, or is not, adequate, but all agree that the great majority of the people are poorly nourished through lack of certain vitamins and mineral substances, and by reason of the poor biological value of much of the protein eaten. But this is no reason to think that the problems are insoluble. Accounts are given of the deficiency diseases that prove the lack of essential foodstuffs, and of the well-planned investigations on human nutrition now in hand by Dr. W. R. Aykroyd and others.

Sir George Anderson deals with the vexed question of education, and sets out clearly the disadvantages of a system which has undeniably turned out a considerable number of unemployables. An important chapter by Sir Frank Noyce deals with industrial labour and the many difficulties that have arisen in the development of a factory system in India. Finally, Mr. C. F. Strickland discusses co-operation, a method which, if it could but develop in India, would go far to solve many of the peasant's difficulties.

Altogether the volume can be strongly recommended, not only to those about to proceed to India, but also to all who are interested in knowing something of the way in which modern administrators tackle the problems that daily confront them there. We suggest to the editor the desirability of giving a short list of the more important of the many reports that have been issued on the various great problems discussed in the book, or alternatively, that they should be quoted as sources of fuller information should this be desired. Some of these reports are of special value but they run the risk of being overlooked, and few men have either time or the courage to attack, without guidance, the great mass of official literature that has now accumulated. Another improvement

would be the inclusion of an appendix summarizing the more important of the statistics discussed in the book.

(2) Prof. Gangulee's book deals entirely with health and nutrition in India, which he, too, regards as the most important problem there. He is unusually well equipped among Indian writers for his task: his early training under Tagore gave him a wide humanitarian outlook; his subsequent career in the United States, at Calcutta and at Rothamsted showed what was practicable in the way of agricultural improvement; his membership of the great Linlithgow Commission in 1926–28 furnished him with full details of the Indian problems; finally, his recent long months of reflection and writing have enabled him to put his ideas into shape.

In a significant dedication to Pandit Nehru, Prof. Gangulee quotes the old saying about India that "for every three mouths there are only two rice bowls" and so aligns himself with those who regard even the total production of food in India as inadequate, quite apart from the recognized inadequacy of vitamins and mineral substances. His suggested remedies are interesting. First and foremost, to overcome the fatalism, even defeatism, which he finds so prominent in Indian life; then, the reorganization of the land system so as to abolish the tendencies to over-fragmentation of holdings in some regions, and over-large holdings in others; and the reorientation of agriculture so that human nutrition becomes its main purpose.

This question of the proper feeding of India is admittedly difficult, but it is now being faced courageously and we may still hope for a successful outcome of the many efforts now being made. One of the most hopeful features in the situation is the keen desire of the leaders of India, the Viceroy, the great social and political leaders, and the administrators, that the standard of life in the villages should be raised. It is now widely recognized that the prime purpose of Indian agriculture should be to produce food in the necessary quantity and of the proper quality, and that for this purpose special efforts must be made to bridge the present gap between the agricultural experiment station and the small cultivator, so as to bring the benefits of science within the reach of the villages of India.

E. J. RUSSELL.

Combinatory Topology

Topologie der Polyeder und kombinatorische Topologie der Komplexe

Von Prof. Dr. K. Reidemeister. (Mathematik und ihre Anwendungen in Monographien und Lehrbüchern, herausgegeben von E. Kamke, Band 17.) Pp. ix+196. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1938.) 14.80 gold marks.

THE first systematic exposition of combinatory topology was made by Dehn and Heegaard in a section of the "Enzyklopädie der mathematischen Wissenschaften", in which the exact concepts involved are only developed as far as the third dimension. The extension of the theory to complexes of higher dimensions was fraught with considerable difficulties; and it was due to the work of M. A. H. Newman that the gap was finally bridged. In the section of the encyclopædia referred to above, he showed that combinatory topology was one of the most primitive branches of geometry, in which the concept of limiting values had as yet no place. In fact, as Prof. Reidemeister describes in detail in the present treatise, combinatory topology turns out to be a well-defined partial domain of the theory of polyhedra—a fact well calculated to demonstrate the elementary character of the subject and to justify Prof. Reidemeister in providing a new and systematic presentation of it.

In Euclidean geometry, a number of geometrical figures known as polygons or polyhedra—triangles, rectangles, cubes, etc.—are both familiar and indispensable. But the general concept of a two- or three-dimensional polyhedron has no part whatsoever in the definitions of these figures. Triangles and cubes are obtained directly from geometrical axioms; and even the more comprehensive class of convex polyhedra is treated as a special convex domain, as a section of a finite number of semi-spaces for example, and not as polyhedra having the additional property of convexity. Although, by virtue of numerous elementary examples, we may be familiar with the abstract idea of the polyhedron, an exact and unequivocal concept such as is essential for any systematic investigation, is lacking. Thus, at the outset, we are, as Prof. Reidemeister says, confronted with a decision the consequences of which present considerable difficulties for further developments.

By Prof. Reidemeister's fundamental definition, in which only the axioms of connexion and order of linear geometry and no continuous properties whatsoever, are assumed, a polyhedron P is an aggregate of points of a linear space R^n. It is in fact an extension of the definition of convex polyhedra given above. The totality of the polyhedra of an R^n is once more a polyhedron, and is,

moreover, the smallest aggregate-ring which contains the totality of the semi-spaces and linear sub-spaces of the R^n.

A polyhedron P can be obtained in two different ways; and the task which follows from Prof. Reidemeister's definition is a twofold one. On one hand, to obtain the connexion between the different methods of representation of P; and on the other, to obtain those properties of P which are independent of the method of representation, from a single representation. This task is accomplished by Prof. Reidemeister in two stages, and forms the substance of the present work, which does not assume much previous knowledge on the part of the reader, of either linear algebra or linear geometry.

The "Handbuch der Zoologie"

Handbuch Der Zoologie:
eine Naturgeschichte der Stämme des Tierreiches. Gegründet von Prof. Dr. Willy Kükenthal. Herausgegeben von Dr. Thilo Krumbach.

Band 4, Hälfte 2: Insecta 2. Lieferung 9. Pp. 128. 16 gold marks.

Band 4, Hälfte 2: Insecta 2 Lieferung 10. Pp. 96. 12 gold marks.

Band 4, Hälfte 2: Insecta 2. Lieferung 11. Pp. 160. 20 gold marks.

Band 4, Hälfte 2: Insecta 2. Lieferung 12. Pp. 160. 20 gold marks.

Band 4, Hälfte 2: Insecta 3. Lieferung 13. Pp. 144+xiv. 20 gold marks.

Band 4, Hälfte 2: Insecta 3. Bearbeitet von Dr. Max Beier und Dr. Friedr. Hendel. Lieferung 14. Pp. 312+xvi. 48 gold marks. (Berlin: Walter de Gruyter und Co., 1938.)

THE parts of this publication now under review complete the three volumes devoted to the Insecta, which comprise 2,756 pages of text and additional pages, and 2,785 figures, all of high merit. The various orders, of which thirty-three are recognized, are dealt with in a remarkably uniform manner considering the different authors involved. Each starts with a short general account including a definition and a historical note. Then follows the morphology of imagines, larvæ and pupæ, after which comes the detailed anatomy, with some reference to the physiology of the various systems, commencing with the integument and ending with the reproductive system. Problems of general interest such as the biology, phylogeny, geographical distribution, palæontology, etc., precede the concluding and often most extensive part, the classification. In the latter, extensive and practical keys are provided. These are most useful since they cover the order as an entirety as it is now known and hence avoid the pitfalls of keys that are drawn up for a particular region where an order may be incompletely represented.

The whole of the first two *Lieferungen* here considered and the first sixteen pages of the third, that is, *Lieferung* 11, are concerned with Diptera, the account of which had been commenced in *Lieferung* 8. It is by Dr. F. Hendel and Dr. Max Beier. There are 296 illustrations and while none of them is original, a large number are taken from the works of the former authority. It would, of course, have been impossible to include a complete list of all the literature of so large and important a group. The difficulty is met by giving a list of ten works each of which has an extensive bibliography. This is supplemented by a selected list of the more important works of the last twenty years, which occupies five and a half pages.

The remainder of *Lieferung* 11 and the first sixty-four pages of *Lieferung* 12 contain Dr. Max Beier's account of the Heteroptera. Of the 105 illustrations with which it is furnished none is original, a number being taken from the works of Handlirsch and of Weber. The last seven pages are devoted to a bibliography.

The same author's account of the Homoptera occupies the remainder of this *Lieferung*, the whole of the next and the first twelve pages of *Lieferung* 14, the last six of which contain the bibliography. Illustrating it are 317 figures; one photograph and one diagram are original, and of the remainder a number come directly or indirectly from the classical work of Weber.

At the end of *Lieferung* 13 are title-pages, list of contents, etc., for the volumes Insecta 1 and 2.

Lieferung 14 with its 312 + xvi pages is by far the largest individual part. In a work like the present, the publication of which has extended over a period of years, it is inevitable that important works and even fundamental contributions to our knowledge of various orders should have been made during the interval: forty-four pages with thirty-one figures have wisely been devoted to remedying this. In such an extensive work also it is to be expected that slips and misprints should occur and these too, few in most orders, have been corrected. It is rather a surprise to find that in the Lepidoptera it should have been found necessary to provide a page and a half of corrections for 171 original pages; this rather suggests faulty

staff work somewhere. The greater part of *Lieferung* 14, 266 pages of it, is devoted to a closely printed index arranged in three columns. This is a most remarkable piece of work, for it contains many thousands of entries which, by means of contractions, signs and full cross references give ready access to the enormous mass of information in the books. To take an example chosen purely at random, under "Sternite" there are more than 100 separate entries referring to the different sternites, their occurrence in the larvæ and the imagines of the various orders where they are mentioned. These entries in turn are cross-referenced.

In the table of contents in *Lieferung* 14 it is stated that Insecta 3 commences on page 1729 and it finishes on page 2756, that is 1028 pages. Yet on the covers of the parts, Insecta 3 does not appear until page 2301, and on the inside of the back cover of the past part it states that Insecta 3 contains "xvi + 1112 Seiten". Such discrepancies are difficult to excuse and provide unnecessary trouble when it comes to binding the volumes. So also will the fact that following the title-page for Insecta 2 we find in the table of contents a complete survey of Insecta 1 as well as Insecta 2 arranged continuously so that they cannot be separated.

By now this well-known general "Handbuch der Zoologie" has made a very definite place for itself in zoological libraries throughout the world. It is practically indispensable in the general library, for no other publication at present available can be regarded as a serious rival. The specialist library naturally depends upon the individual memoirs and researches in its own field appearing in scientific periodicals. But even here the "Handbuch" will prove of value since its full summaries of the fundamental work in each group up to date will furnish satisfactory stepping-off places. Indeed some specialists would do well to consult the volumes so as to orientate their particular studies to knowledge of a wider field and not get entirely lost in one small corner. It is the greater pity, therefore, that its price puts it beyond the reach of many who would wish to have more constant access to its pages. The three volumes devoted to Insects have a total cost of Rm. 379 which, even allowing for a possible rebate of 25 per cent, represents at the present rate of exchange an outlay of more than £25 0s. 0d. This is more than the average worker in university or research station, or indeed a small general department, can contemplate spending on such a book, good though it may be.

Wireless Direction Finding

Wireless Direction Finding
By R. Keen. Third and enlarged edition. Pp. xi+803. (London: Iliffe and Sons, Ltd., 1938.) 25*s*. net.

WHEN the first edition of this book appeared in 1922, interest in wireless direction-finding was confined to a comparatively few individuals who were engaged either in the practice of the art for navigational purposes or in its application to a scientific study of the propagation of radio waves. Since the second edition appeared more than ten years ago (see review in NATURE, March 10, 1928), the scope and application of wireless direction-finding have increased considerably. Its use in connexion with marine navigation has become more widespread and has acquired greater reliability, while more recently it has become a very important aid to the navigation of aircraft. The appearance of the third edition, dealing in a comprehensive manner with the most up-to-date aspects of the subject, definitely establishes Keen's book as a standard work, which should be in the hands of all those engaged in the design, manufacture and installation of direction-finders, or in the study and application of the results obtained therewith.

On the research side, this instrument continues to be a very useful tool in connexion with scientific investigations of the propagation of electric waves, including those unwanted waves of natural origin known as atmospherics. In a foreword to the edition under review, Mr. T. L. Eckersley stresses this aspect of the subject and directs attention to the efficient manner in which the scientific and technical sides of the art have advanced hand in hand.

In order to make room for new material, the author has had to delete the portions of the second edition dealing with the use of directive aerial systems for communication purposes only. Even so, the book has increased in size from less than 500 to more than eight hundred pages. After a brief historical introduction an explanation is given of the principles of the various types of directive aerials and the manner in which they are influenced by electric waves. Detailed descriptions follow of the types of direction-finding apparatus used for shore, ship and aircraft installations, and of the various phenomena

encountered in these three spheres of application. The limitations imposed on the various types of instrument by vagaries in the propagation of waves are described in some detail, together with the manner in which these limitations have been overcome or reduced in importance. A chapter on systems of direction-finding which do not yet appear to have earned 'commercial' success includes the instrument giving a visual indication of bearing by the aid of a cathode ray tube. Recent developments in connexion with this instrument indicate that it may soon be expected to emerge from its experimental shell, in which it has for so many years proved a most invaluable tool for the scientific investigator.

A well-arranged bibliography of selected papers is included in the book, and this will prove very useful to the student or research worker who wishes to delve deeper into the subject.

R. L. SMITH-ROSE.

Molluscs of the Great Barrier Reef

Great Barrier Reef Expedition, 1928–29

Scientific Reports, Vol. 5, No. 6: Mollusca, Part 1. By Tom Iredale. Pp. 209–426 + 7 plates. (London: British Museum (Natural History), 1939.) 15*s*.

THIS volume deals with the Lamellibranchia, excluding the Eulamellibranchia. The Barrier Reef Collection was augmented by dredgings around the Low Islands, with a few from the Queensland mainland. These regions the author names the Solanderian and Banksian divisions of the Australian fauna. A short history of reef exploration in the area, from Captain Cook to Hedley and his collaborators, is followed by a discussion of the criteria providing a basis for the classification of lamellibranchs. The author's scheme of classification is given, and the remainder of the book is devoted to a description of families, genera and species. More than two hundred species or subspecies are described and of these more than half are new. The six half-tone plates from drawings by Miss Joyce K. Allan and the photographs of oysters by Mr. Clutton are clear and adequate for identification of the shells. No index is provided, not even page references to families—an omission that may be rectified, perhaps, in the next part. A list of literature is also needed.

The study of this large class has been in the hands of three types of specialist, the geologist, the conchologist and the anatomist. Each has attempted to elucidate the evolution and relationships of the members of the Lamellibranchia from his own particular studies and is inclined to believe that the characters of a hinge, a gill or some other structure are sufficient for the purpose. The study of the dead shell, whether fossil or recent, has either tended to over-emphasize features which may be convergent, or, as Morley Davies pointed out (*Proc. Malac. Soc.*, p. 322; 1933) to divide orders and genera *horizontally* instead of *vertically*, so that their polyphyletic origin is masked.

We are, in fact, driven back to two important tenets in scientific philosophy. First, the specialists must pool their knowledge in order that a sound judgment can be made; no one of the three mentioned is competent to do it alone. Secondly, the features indicating affinity are likely to be those deep-seated characters that are little affected by the environment. Thus the conchologist has often been at fault because he has been too insistent on his own infallibility, the anatomist has rarely been also a geologist and conchologist and so has not obtained the full benefit of his anatomical studies. Moreover, the work on fossils and recent shells is far greater than that on the bodies of the animals themselves, and until this disproportion is corrected, the classification of any of the Molluscan classes must be regarded as unsatisfactory.

Mr. Iredale has clarified the issue considerably by attempting to combine the results of the geologists and conchologists with some anatomy. But his dogmatic and scornful attacks on other workers are unwise, since his own classification is not invulnerable, and in any case acerbity is dying out in scientific literature and may well be allowed to perish. He is to be commended for raising the anomalous Trigonias to ordinal rank, a position to which their deep anatomy also entitles them. Family rank for Watson's sub-families among the Pectiniformes is also sound, but the grouping of the Malletiidæ with the Nuculidæ can be questioned, since anatomically, especially as regards the pericardial complex, their relations are with the Solemyidæ. Unfortunately, no Malletiids are described, so we do not know why the author arranged them thus.

Iredale is critical of the specialist in Europe who names the Australian fauna, and he stresses the importance of the local worker, who alone can study the variability of a species in its own home. He is quite right and the remedy is in his hands. Let him encourage Australian naturalists to carry on the work he has begun.

The Cycle of Weathering

By Prof. B. B. Polynov. Translated from the Russian by Alexander Muir. Pp. xii+220. (London: Thomas Murby and Co., 1937.) 10*s*. 6*d*. net.

THE science of weathering is fundamental in any study concerned with such a question as why the mineralogical composition of the surface material of the earth is as it is. It is therefore a fundamental science in the study of how geological deposits and soils came to have their present composition. Although this science is so fundamental, it possesses very few established facts. In Nature, weathering is exceedingly slow and very complex, with the consequence that until recently very few methods have been available for examining exactly what chemical processes are taking place. The science of weathering has thus been built up rather more on plausible guess-work than on established fact.

The author of this book, who is one of the leading Russian soil geologists, has not attempted to give a critical presentation of the subject in which the various rival theories are weighed and tested against known experimental data. The book is much more a monograph in which the author sets out to give a general survey of the field of weathering as he himself sees it. He discusses the types of weathering that can take place, and follows up in some detail the cycle of compounds which the commoner chemical elements pass through while in the earth's surface.

In the last chapter the author discusses the effect of topography and of the soil hydrological conditions on the rate at which weathering proceeds. He shows how, in a region having uniform climate and parent material, soils of quite different types would be expected, ranging from the most mature and leached soils on the divides to the most immature soils in the valleys. This effect constitutes what can be called the geomorphological limitation of the theory of the existence of climatic soil groups. This chapter is one of the most suggestive in the book, and the reviewer only regrets that it was not made longer so that more detailed illustrations could be given of the effect of topography. But if it serves as a stimulus for a fuller examination of this effect the book will have been more than justified. E. W. R.

Scoliodon (the Shark of the Indian Seas)

By Dr. E. M. Thillayampalam. (Indian Zoological Memoirs on Indian Animal Types, 2.) Second edition, revised and enlarged. Pp. xiv+126. (Lucknow: Lucknow Publishing House, 1938.) 2.8 rupees.

PROF. BAHL has now presented us with seven memoirs, each dealing with an Indian animal typical of some phylum and taught as a type of the same. The taxonomic position of each is shown, its anatomy and such parts of its physiology as are concerned with its habits in life. The classificatory position in relation to the rest of the Elasmobranchii is carefully considered, aided by forty-nine line illustrations, these leading up to the history of the genus *Scoliodon* and the consideration of the species.

The anatomical account which follows is interestingly written and excellently illustrated. We are pleased to see modern views on locomotion, and we think the student would be helped by a more 'functional' tone throughout the anatomy. In particular, we should like to see a stronger treatment of the brain and cranial nerves, the broad functions of which apply to all the higher vertebrates.

Physiology of the Central Nervous System and Special Senses

By Prof. N. J. Vazifdar. Seventh edition, revised and enlarged. Pp. x+307+vii. (Bombay: Popular Book Depot; London: H. K. Lewis and Co., Ltd., 1938.) 10*s*. 6*d*. net.

A MEDICAL work which has passed through seven editions in less than thirty years does not require any further recommendation. It is sufficient to say that the present edition has been well brought up to date and will be found a valuable handbook by the practitioner and student alike.

The text is liberally interspersed with illustrations of the different types of nerve cells, tracts of white matter, transverse sections of the spinal cord, pons and mid-brain, the results of lesions at various parts of the central nervous system, and the structure and function of the special senses.

Fish Passes in Connection with Obstructions in Salmon Rivers:

being the Buckland Lectures for 1937. By T. E. Pryce-Tannatt. Pp. 108. (London: Edward Arnold and Co., 1938.) 3*s*. 6*d*. net.

THE subject chosen for the Buckland Lectures for 1937 by Dr. T. E. Pryce-Tannatt was appropriate, for Buckland himself was an inspector of salmon fisheries and was concerned with the question of obstructions in the courses of rivers. This book outlines the laws regarding obstructions, considers the obstructions in relation to the habits of the fish, and describes the types of fish passes in existence. The problems concerned with the choice of pass best suited for the varying circumstances are discussed, and thirty-two diagrams and photographs of the different kinds of obstructions and fish passes are given. It maintains the standard of this useful series of publications.

An Inorganic Chemistry

By Dr. H. G. Denham. Third edition. Pp. viii+694. (London: Edward Arnold and Co., 1939.) 12*s*. 6*d*. net.

THE main alterations in the new edition of Prof. Denham's book are concerned with the modern view of strong electrolytes and with valency. The last chapter has been extended so as to give a broad outline of the modern theory of valency. The book is of intermediate standard, and particular attention is given to the systematization made possible by the use of the Periodic System.

The possibility of predicting many properties of the compounds of the elements from those of the oxides is also used. The continued popularity of the book may be confidently expected in its new form.

Solar Variation and the Weather

By Dr. C. G. Abbot, Smithsonian Institution

WHILE he was visiting the United States at the end of last year, Sir Richard Gregory invited me to contribute to NATURE a general review of the results of the long campaign of the Smithsonian Institution on the variation of the sun, which was instituted by the late secretary, S. P. Langley. Thus far it has accomplished about 40,000 measurements of the solar constant of radiation, involving observations filling about 10,000 days, besides numerous and interesting side researches. A more detailed account of results is expected to appear in the April issue of the *Quarterly Journal of the Royal Meteorological Society*.

In 1903, by what now seems only a coincidence, a large drop occurred in our measurements at Washington of the solar constant of radiation, and simultaneously a considerable fall from mean temperature occurred generally over the north temperate zone. To test the possibility thus advanced that solar changes occur which govern weather, we began to make day-to-day observations of the solar constant at Mount Wilson Observatory in the year 1905. These continued during the summer and autumn months until 1920. The results, which treat of solar variation, of the transparency of the atmosphere, of the quantity of its precipitable water, of the coolness of sunspots, of the brightness of the sky by day and by night, of the distribution of solar radiation in the different wave-lengths of the spectrum, of the distribution of radiation over the sun's disk, and which involved the invention of various instruments, including the silver-disk, water-stir, and water-flow pyrheliometers for measuring solar radiation in standard units, the pyranometer for measuring the brightness of the sky, the automatic recording balloon pyrheliometer, and others, are described in volumes 2, 3 and 4 of the *Annals of the Astrophysical Observatory* of the Smithsonian Institution. During these Mount Wilson years, I made expeditions to Mount Whitney, 14,500 ft. in altitude, and to Bassour, Algeria, to test whether similar results on the solar constant of radiation are found simultaneously at stations of different altitude and far separated. Also, in 1913 and 1914, automatic recording pyrheliometers were raised by sounding balloons. The most successful flight reached 25,000 metres, and brought back records which closely agreed with solar constant values obtained at Mount Wilson and our other stations.

Up to 1919 our observations of the solar constant had all been made by the fundamental method of Langley. Briefly, it consists in measures of the intensity of sun rays at the station, supplemented by spectrobolometric determinations of the distribution of intensity in the solar spectrum. Both types of measurement were made simultaneously, and repeated about five times daily, beginning when the sun is not more than an hour high, and continuing until it approaches maximum elevation. After correcting for instrumental losses, the area included under the bolographic curve of the spectrum is corrected to be proportional to the pyrheliometer measurement of the total solar beam intensity. Then, by computation, each part of the spectral curve is raised to the intensity it would have outside the atmosphere. Then the area included under this computed extra-atmospheric curve, divided by the area of the corrected observed curve, is the multiplier to increase the pyrheliometer reading to what it would be outside the atmosphere. After reducing this to mean solar distance, we have the solar constant of radiation.

With the long computation involved, usually but one determination could be made by this method per day. Its accuracy, apart from instrumental and computing errors, depended on perfect uniformity of the transparency of the atmosphere for several hours. If the sky was clearing up, the result was too high; if growing hazy, the result was too low.

With these drawbacks, it is not remarkable that many meteorologists were not convinced that our results indicating solar variability were sound. They were inclined to think them merely accidental consequences of imperfect observation, or imperfectly uniform sky. Mr. H. H. Clayton, however, who has deserved specially well of meteorologists as editor of "World Weather Records", was at that time chief forecaster of the Argentine. He became convinced by Mount Wilson solar constant work, not only that the sun is really variable, but also that its variations are of first-rate consequence for meteorology.

To show the reasonableness of his views, I may remind readers that the accidental error of a mean diminishes with the square root of the number of observations. Mr. Clayton made use of this

principle. He collected all the solar constant values of the years 1913, 1914, 1915, and 1918, and placed them in six groups ranging from 1·89 to 2·01 calories, of which I abstract the highest and lowest as follows :

DEPARTURES FROM NORMAL TEMPERATURES (F.) AT BUENOS AIRES FOLLOWING DIFFERENT INTENSITIES OF SOLAR RADIATION (MAY TO NOVEMBER)

Solar Constant (Cal. per min.)	Number of Days Observed	Days after Solar Observation														
		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
2·00 ± 0·01	29	−2·2	−1·3	−0·9	−1·4	−1·3	−0·4	−0·4	+0·5	+2·7	+2·9	+3·6	+2·5	−0·2	+0·2	+0·4	+1·1
1·90 ± 0·01	30	+1·8	+1·8	+4·1	+2·3	−1·6	−1·8	−1·8	−2·7	−1·4	−0·9	−2·5	−0·9	+0·2	−0·5	+0·4	−0·5

The opposite trend of these values of temperature departures is obvious. Of sixteen pairs of values just given, the signs of twelve pairs are opposite. As the numbers of observations are so large, the accidental error of the mean values, approximately 2·00 and 1·90 calories, respectively, is only about one fifth as great as the average accidental error of the individual days. Hence the probability that we deal here actually with well-separated levels of solar radiation is strong. The marked opposition of the average marches of temperature departures, following the contrasted observing dates, certainly gives definite significance to these dates, and if it be not the variation of the sun, it is at least something of forecasting value.

These and other meteorological applications of Clayton's led us to wish to improve and render more continuous our solar constant programme. In 1918, therefore, we established a solar station at Calama in the nitrate desert of Chile, at a level of about 6,000 ft. From that time to the present we have endeavoured, so far as possible, to make one or more solar constant determinations on every fair day. While most of this work has been supported by the United States Government, large sums in aid have come from the income of the Hodgkins Fund of the Smithsonian Institution, from Mr. John A. Roebling, and from the National Geographic Society. At present we operate three observing stations : Montezuma, near Calama, Chile, altitude 9,000 ft. ; Table Mountain, Southern California, altitude 7,500 ft. ; Tyrone Station on Burro Mountain, New Mexico, altitude 8,000 ft.

In 1919 we noticed that the coefficients of atmospheric transmission for all wave-lengths of radiation could be empirically represented, to an excellent approximation, as specific functions of the brightness of the sky near the sun. This enabled us to multiply observations of the solar constant daily as the measurements were quickly made. Also, as the sky brightness could be almost instantaneously determined, the new method avoided errors due to changes in atmospheric transparency. In all recent years we have preferred this empirical 'new method', but fearing that presence of volcanic dust, or some other unusual atmospheric condition might affect it, we have frequently checked its results by employing the fundamental method of Langley.

Now I come to state the outstanding results of this long-continued daily recording of the intensity of the solar radiation. Solar variations are small but real. We may assign as the average amplitude for one combined rise and fall of the solar constant, 0·7 per cent. Such variations as this may be expected to occur about once in twenty days. That is, we may expect annually about twenty cases of rise and twenty cases of fall to give well-marked sequences of solar change averaging 0·7 per cent, and extending from three to six days during such a sequence. Rarely, however, solar changes of several times this amplitude may occur.

In order to set out the evidence quite clearly, I will refer to results published in a paper of mine three years ago. Having searched the record for the 12-year interval 1924–1935, I found 320 well-marked cases of solar change, about half of rise and half of fall. I divided these into monthly groups, so that there were about fourteen cases of each kind per month on the average. Some good months had as many as twenty, and only one test, that of falling radiation in February, was represented by less than ten dates.

For each of the 320 dates, I computed the departures from normal temperature at Washington and at three other cities for 16 days following the supposed solar change. Recalling that there were from ten to twenty cases of each kind for each month, it will be seen that by taking the mean results, I obtained fairly strong representations of the average march of departure from normal temperature which follows in each month of the year at Washington and at the other places, after a sequence of rise or of fall of solar radiation is observed to begin.

In every month these average marches of temperature departures showed opposite trends following, respectively, observed rise and observed fall of solar radiation. It would be more striking to show here a plot covering all months, but I content myself, in illustration, with giving merely the figures for October at Washington. Interested readers may plot them. The figures are adjusted to give zero average temperature departure after both rising and falling radiation, by adding

appropriate constants throughout to each of the lines of departures as originally computed. A third line gives the deviations which would be found if a curve representing 'falling' departures were folded over upon a curve representing 'rising' ones.

THE AVERAGE TRENDS OF OCTOBER TEMPERATURE DEPARTURES (F.) FOLLOWING, FOR 16 DAYS RESPECTIVELY, RISING AND FALLING SOLAR RADIATION

Days after	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Rising	−1·0	−2·6	−3·0	−1·6	0·8	0·3	0·8	4·9	6·5	5·3	1·4	−0·7	−1·5	0·3	−1·4	−5·2	−3·7
Falling	2·2	1·9	1·2	−0·6	−0·7	1·9	−2·1	−4·6	−4·8	−3·8	−2·7	2·0	0·0	0·0	0·8	4·0	5·9
Folded discrepancy	+1·2	−0·7	−1·8	−2·2	+0·1	+2·2	−1·3	+0·3	+1·7	+1·5	−1·3	+1·3	−1·5	+0·3	−0·6	−1·2	+2·2

Number of signs of departures same for two groups	..	2
" " " " " opposite "	..	15
Range of departures following rising radiation "	..	6·5° − (5·2°) = + 11·7°
" " " " " falling "	..	−4·8° − 5·9° = − 10·7°
Arithmetical mean 'folded discrepancy'	..	± 1·3°

The range of temperature is so large that it is difficult to accept the conclusion that so great an effect is really caused by radiation changes of the order of 0·7 per cent. Hence I have tested the result in several ways. First, as shown in my paper, when comparing the earlier with the later years, the curves are very similar for the years 1924–30, as compared to the years 1931–35. Secondly, selecting 46 cases of unusually large change in the observed solar radiation, I found them followed on the average by temperature departures exhibiting features the same in phase, but of about twice the average amplitude, of those following usual observed solar changes. Thirdly, and most telling of all, I considered time next *preceding* each of the 320 selected dates. I computed for each of these cases the temperature departures of the *preceding* 16 days. Then I determined correlation coefficients between the march of temperatures for 16 days *preceding* and for 16 days *following* the cases of rising solar radiation and the cases of falling solar radiation. The result was highly significant, and is as follows:

Prior to solar change, $r = +11 \pm 6$ per cent.
After solar change, $r = -54 \pm 5$ per cent.

Thus there is no significant correlation of the trends of temperature for 16 days *preceding* rising and falling sequences of observed solar radiation, but *after* the solar change there is a negative correlation coefficient eleven times its probable error. Evidently the 320 dates were significant; but they were selected only because observation indicated that rise or fall in solar radiation began with them.

Similar results as regards opposition of trends and magnitude of their separations are found at each of the four temperature stations selected in different parts of the world. The effects are large, ranging from 10° to 20° F. I see no other reasonable conclusion than this. Solar changes exist, and are factors of prime importance governing day-to-day weather changes. Apparently if the sun's changes could be observed with accuracy from day to day, meteorologists would receive a new and important element, which might probably enable them to predict details of weather for two weeks in advance. To attain the necessary accuracy and continuity of solar observation would require, I think, ten stations on high mountains in desert lands.

Long-range solar variations are also interesting. When we take monthly mean values, their accidental errors are reduced on the average by more than fourfold as compared with daily values, because from sixteen to twenty-five daily values enter into each monthly mean. Moreover, our three stations, separated by thousands of miles, agree fairly closely in their indications of the trend of solar variation over many years.

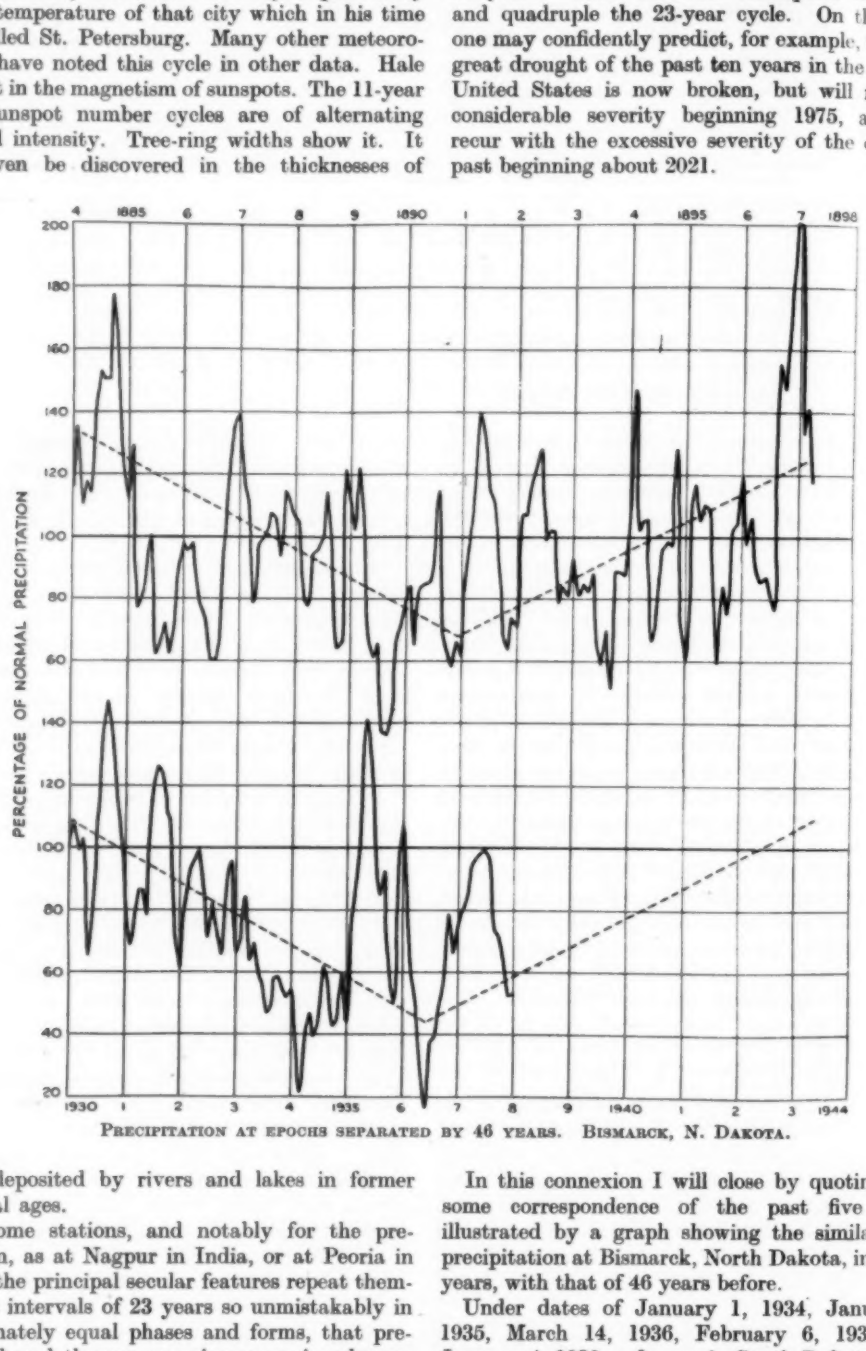
As we scan the curve of solar change since 1920, it appears to be irregular. But I have analysed it, searching for all the regular periodicities which it may contain. I have found twelve of them, ranging from 7 months to 274 months in length, and 274 months proves to be approximately the least common multiple of them all. In the case of half these periodicities, it was possible to derive them independently from two, or even three separate successive intervals, and to show satisfactorily that they persisted in approximately equal phases and amplitudes throughout the total interval of fifteen years. For the longer periods, exceeding thirty months, this check was not available. However, there was still evidence, by comparing individually several successive recurrences, that these longer supposed periodicities repeated in nearly the same phases and amplitudes.

On synthesizing these twelve periodicities, they retraced the observed trend of solar variation from 1920 to 1934 so exactly as to give an average monthly deviation from observation of only 0·2 per cent.

If, now, 274 months, or approximately 23 years, is really a master cycle in the sun, it may well be expected to reveal itself also in weather. It does

so. As noted by Wild, there is a 23-year periodicity in the temperature of that city which in his time was called St. Petersburg. Many other meteorologists have noted this cycle in other data. Hale found it in the magnetism of sunspots. The 11-year Wolf sunspot number cycles are of alternating unequal intensity. Tree-ring widths show it. It may even be discovered in the thicknesses of varves deposited by rivers and lakes in former geological ages.

For some stations, and notably for the precipitation, as at Nagpur in India, or at Peoria in Illinois, the principal secular features repeat themselves at intervals of 23 years so unmistakably in approximately equal phases and forms, that predictions based thereon covering years in advance are fairly well verified. More important is the recurrence of severe drought conditions at intervals of 46 years, and recurring still more severely every 92 years. These intervals correspond to double and quadruple the 23-year cycle. On this basis one may confidently predict, for example, that the great drought of the past ten years in the western United States is now broken, but will recur in considerable severity beginning 1975, and will recur with the excessive severity of the one just past beginning about 2021.



PRECIPITATION AT EPOCHS SEPARATED BY 46 YEARS. BISMARCK, N. DAKOTA.

In this connexion I will close by quoting from some correspondence of the past five years, illustrated by a graph showing the similarity of precipitation at Bismarck, North Dakota, in recent years, with that of 46 years before.

Under dates of January 1, 1934, January 1, 1935, March 14, 1936, February 6, 1937, and January 4, 1938, a farmer in South Dakota asked me to predict for him in each case a year in advance the trend of precipitation, and sometimes also of temperature. That area has suffered greatly from

drought in recent years. With strongly expressed cautionary statements as to the insecurity of such predictions, I have given him, year by year, the following indications.

1934: "There will be more precipitation in Minnesota and the Dakotas in 1934 than in 1933, but it will be in the latter half of 1934 that the relief will come."

1935: "One could hardly expect normal rainfall in South Dakota in 1935."

1936: "Precipitation far below normal, but with some improvement in the autumn. As regards temperature, the year 1935 followed almost exactly the pattern of temperature 46 years ago, i.e., 1889. If 1936 should follow 1890, it should show a very cold winter (as indeed has occurred), followed by normal temperature in spring and the early part of the summer."

1937: "A good precipitation in the spring or early summer of 1937, followed by a dry autumn and winter, recovery in the spring of 1938."

1938: "Normal precipitation during the first six months of 1938, with some (but not excessive) let-down for the remainder of the year, and for the first five months of 1939. Then a short dry spell in the middle of 1939, but precipitation normal or above normal after November 1939 for considerable time."

In January 1938, my correspondent said: "Because of the accuracy of your former predictions of weather conditions for the Dakotas, I am again soliciting your predictions for the coming season. I have much confidence in your ability to predict, therefore please do your best once more."

These forecasts were made by studying the departures from normal conditions at Bismarck, North Dakota, 46 years previously. How well they were fulfilled is to be estimated by examining the accompanying graph.

Use of Isotopes in Biology

THE discovery both of artificial radioactive elements and heavy non-radioactive isotopes, together with methods of concentration of the latter, has opened up new methods of examining the reactions and movements of substances in the body.

The isotopic indicator most frequently used in biological research is radioactive phosphorus (^{32}P) which may be prepared by the bombardment of carbon disulphide by neutrons from a radium-beryllium source. The sulphur atom takes up a neutron and gives out a proton, forming heavy, unstable, radioactive phosphorus (half-life period 14 days):

$$^{32}_{16}S + ^{1}_{0}n \rightarrow ^{32}_{15}P + ^{1}_{1}H.$$

The phosphorus is then oxidized to phosphate. Stronger preparations may be obtained by bombarding red phosphorus with deuterium ions using a cyclotron:

$$^{31}_{15}P + ^{2}_{1}D \rightarrow ^{32}_{15}P + ^{1}_{1}H.$$

For use, a small amount of the labelled sodium phosphate is added to ordinary sodium phosphate solution, and by this means the path of the phosphorus in the body can be traced. Estimations are carried out by observing the decay, at a given time, using a Geiger counter, and comparing directly with the decay of a similar standard at the same time, thus avoiding corrections for the rate of decay due to lapse of time. Thus if it is desired to determine the radioactive phosphorus content of the bone of an animal to which a labelled phosphate solution has been administered (and hence determine any exchange in the phosphate of the bone), a known weight of bone ash from the animal is placed under the Geiger counter and the strength observed. This is compared directly with the same weight of calcium phosphate, precipitated together with the labelled phosphate from a known weight of solution. This method has placed an extremely delicate method of estimation in the hands of the experimenter and has the great advantage that it is not necessary to purify the substance carefully from non-radioactive elements.

Of the non-radioactive elements, deuterium (^{2}H) has been isolated in a state of purity; while heavy oxygen (^{18}O) and heavy nitrogen (^{15}N) have been concentrated sufficiently to make their use as indicators possible.

Heavy hydrogen and oxygen may be accurately estimated by conversion to water, and, after careful purification, determination of the density of the latter. Heavy nitrogen is determined by the mass-spectrograph. This method may also be used for the determination of heavy oxygen: it has the advantage that very careful purification is unnecessary.

It may be objected that the use of isotopes as indicators in the living body may disturb the normal conditions. Actually, the proportion of radioactive phosphorus which it is necessary to use is extremely small, and the radiation from it may be comparable with that from the potassium which is already present in the body, and on decaying it is converted to a sulphur atom. Heavy

non-radioactive isotopes are also already present in small proportions in the body, and the use of a slightly greater concentration as an indicator should not be objectionable. In the case of deuterium, it may be best to avoid the use of concentrated preparations.

A joint meeting of the Chemical Society and the Physiological Society on February 9 last took the form of a discussion on the use of isotopes in biology, which was opened by Prof. G. von Hevesy, of the Institute of Theoretical Physics, Copenhagen.

Among examples of the use of radioactive phosphorus, Prof. Hevesy described the results of experiments in which labelled sodium phosphate was injected intravenously; blood samples of known volume taken at intervals showed a very rapid decrease at first, followed by a slow decrease, in the labelled phosphate. This was found to be taken up by the bones and organs of the body, but chiefly by the former. It can be shown, by shaking up solid calcium phosphate with labelled phosphate solution, that there is a rapid exchange between the phosphate ions and the phosphate in the solid, the rate depending on the concentrations of the ions and the surface area of the solid. In the case of the body, the weight of the solid phosphate in the bones is very great compared with the inorganic phosphate in the blood, and most of the labelled phosphate will exchange with ordinary phosphate on the surface of the bones. As phosphate is lost by excretion through the kidneys and bowels, the uptake of labelled phosphate by the bones will cease, and finally, when the labelled phosphate in the blood is nearly removed, there will be a slow exchange of labelled phosphate back from the bones to the blood. Thus it may be possible to detect labelled phosphate several weeks after administration. Examination of the separate organs of the body enables the passage of the phosphate to be followed, and similarly examination of sections of bone shows that the rate of exchange of phosphate varies with different bones. In the case of growing bone such as the teeth of rats, the greater activity is found in the tooth formed after the addition of the labelled phosphate; the part formed before the addition, however, also shows some activity, indicating that exchange of phosphate takes place at the same time as new growth.

Phosphorus atoms in an organic molecule such as lecithin do not exchange with labelled sodium phosphate. Thus, if active lecithin is found, it indicates that the lecithin molecule has been synthesized after the administration of the labelled sodium phosphate (in the presence of suitable enzymes) and thus a distinction can be made between old and new molecules. This method may be used, for example, to find the place of formation of the phosphatides in the yolk of hens' eggs. By killing a hen five hours after an injection of labelled phosphate, it was found that the liver and plasma phosphatide were very active (the former more than the latter) compared with that in the ovary and yolk; thus the phosphatide molecules formed during the last five hours do not originate in the ovary, but are taken by the ovary from the plasma and used in the building up of the yolk. It was also found that after the egg had left the ovary no labelled phosphatide was formed in it. This was shown by examination of eggs laid less than 20 hours after administration of labelled phosphate (the egg, after leaving the ovary, remains in the oviduct about 20 hours).

The use of radioactive sodium phosphate has also been of great help in a study of the formation of (goat) milk. Samples of blood and milk taken at intervals after administration of labelled phosphate were examined for the activity of the phosphate in the blood and the various phosphorus compounds in the milk. It was found that after three to four hours the milk inorganic phosphate was replaced by the active phosphate of the plasma; while if heavy water was injected at the same time as the active phosphate, after one hour water samples prepared from blood and milk had the same density, the difference in the rates being due to the fact that water molecules diffuse through the membranes at a greater rate than phosphate ions. From the rate at which the casein phosphorus becomes active, compared with the active inorganic phosphorus in the milk, it was estimated that the time of formation of casein in the gland cells was about one hour.

The fact that a few hours after addition of the labelled phosphate the milk phosphatides are only slightly active compared with the inorganic phosphate, indicates that the latter cannot be produced from the former, thus contradicting the view that the fats and inorganic phosphate are produced by the breaking up, in the milk gland, of the phosphatides of the blood. The investigation of problems of milk secretion was also referred to by Dr. S. K. Kon.

Labelled sodium phosphate has also been used in a study of the movements of phosphate in plants. Maize and sunflowers grown first in a culture solution were then transferred to a second solution containing labelled phosphate. The leaves which grew while the plant was in the second solution were examined for activity and compared with the leaves which grew in the first (inactive) solution. It was found that, after four days, the lower leaves had 80 per cent of the activity of the upper leaves, showing that a rapid replacement of phosphate took place. Similar experiments have been carried out using heavy nitrogen as indicator.

The use of deuterium as an indicator was discussed by Prof. H. S. Raper and Dr. W. E. van Heyningen. The former referred to the work of Cavanagh and Raper, in which fats labelled with deuterium were fed to animals and a study made of the rate of formation of the deuterium labelled lipins in the liver and kidney; the latter gave an account of the work of Schoenheimer and Rittenberg *et al.* on deuterium as an indicator in the study of intermediary metabolism, and referred especially to the uses and limitations of the method.

The use of heavy oxygen as an indicator was discussed by Dr. J. N. E. Day. He referred to the work of Aten and Hevesy, who examined the possibility of exchange of oxygen in sulphate, with other oxygen atoms present in the body, by injecting heavy sodium sulphate into rabbits, and concluded that there was little or no exchange. Reference was also made to the work of Day and Sheel on the use of heavy oxygen in animal respiration, in which the heaviness of the expired carbon dioxide was determined.

Radioactive sodium was dealt with by Dr. B. G. Maegraith, who mentioned experiments in which active sodium chloride had been injected into rabbits, and the distribution of the active sodium investigated. He suggested that this might be used to estimate the extracellular fluid content of the rabbit.

Dr. W. D. Armstrong described experiments dealing with the exchange of phosphorus of the enamel of teeth and the blood using radioactive phosphorus. A very slow exchange was noticed, indicating, not the formation of new molecules, but exchange of phosphate between enamel and blood. Mr. C. H. Collie referred to work of Collie and Morgan showing that radioactive sulphur can be used as an indicator.

Dr. D. Roaf described a method of producing radioactive phosphorus by irradiation of tricresyl phosphate with slow neutrons.

Obituary Notices

Prof. Franz Werner

PROF. FRANZ WERNER'S death, which took place in Vienna on February 18 after a short illness at the age of seventy-two years, came as a shock to his numerous herpetological friends and colleagues the world over. Born in 1867, Franz obtained his doctorate at the University of Vienna in 1890 at the early age of twenty-three years, was appointed assistant in the First Zoological Institute of the University, later rising to be professor there, and had a distinguished record as a teacher until 1933, when he became emeritus professor. For more than fifty years, almost up to his death, he was zealously engaged in zoological researches, being in the foremost ranks of European herpetologists and a recipient of many honours. He was a corresponding member of the Vienna Academy of Sciences, an honorary doctor of the University of Athens, an honorary member of the American Society of Ichthyologists and Herpetologists, and a member of numerous other scientific societies.

Prof. Werner was a prolific writer, having more than a hundred papers, including some voluminous works, to his credit, the list including not only papers on Amphibia and Reptilia, in which he was principally interested, but also titles on Orthoptera and scorpions. Interested at first in morphological problems, he became more and more devoted to faunal exploration and herpetological taxonomy as the years went by. He undertook many travels for the sake of such study, and made valuable contributions to our knowledge of the fauna of Greece and the Ægean Islands (1902, 1912, 1927, 1930, 1933, 1935, 1936, 1937), Algeria and Morocco (1914, 1929, 1931), Asia Minor (1902, 1903, 1905, 1929), Persia (1903, 1917, 1929, 1936), South and West Africa (1902, 1913, 1915), Anglo-Egyptian Sudan (1914, 1919, 1924), Guatemala (1903), the Andes (1916), China (1903, 1924), etc. His contributions on Chamæleontidæ (1911), Eublepharidæ, Uroplatidæ, Pygopodidæ (1912) and Reptilia Loricata (1933) in "Das Tierreich"; on Amphibia and Reptilia in Brehm's "Tierleben" (1913); and on Amphibia (excluding Anura) in Kükenthal's "Handbuch der Zoologie" (1930–31) are models of deep learning and lucid expression, and will make him familiar to younger generations of herpetologists even when the charm of his personality is long forgotten.

He was a patient, enthusiastic and indefatigable worker for herpetology. B. C. MAHENDRA.

Dr. E. H. Hankin

THE death on March 29 of Ernest Hanbury Hankin at the age of seventy-four years removes one who in the early days of the development of bacteriology did much to forward its practical applications. The son of a clergyman, he was educated at Merchant Taylors' School, at University College, London, and at St. John's College, Cambridge, of which he was a scholar and later a fellow, obtaining the M.A. and Sc.D. degrees. He also studied at St. Bartholomew's Hospital for a time, but did not proceed to a medical qualification, and worked in Koch's laboratory in Berlin and in the Pasteur Institute, Paris. He then accepted an appointment as chemical examiner, analyst and bacteriologist to the North-West Provinces and Oudh, India, and spent his professional

although we were living in times of financial stress, when it was impossible to devote as much money as could be wished to work of this character, he was not without hope that the outcome of Sir Leonard's visit would be greatly to the advantage of the cause of Indian archæological exploration and research. His concluding remarks were especially noteworthy: "As a people", he said, "we should surely stand condemned if, when judgment was passed on us at the bar of history, it should be said of us that we had neglected in our long contact with India those cultural values, which alone raised man above the level of the animal world and were an index of his achievement in the domain of the spirit."

Neanderthal Man in Central Asia

AN announcement of a discovery in the Uzbek republic of the U.S.S.R. of very considerable interest is announced by the Russia To-day Press Service. The skeleton and other traces of man of palæolithic age have been found in a cave some twelve miles north-west of the town of Baisun. Stone implements found on the site are said to fix the date of the stratum, in which the discovery was made, as late Mousterian. Prof. Gerasimov, the well-known Russian archæologist, has succeeded in restoring the skull, and a commission has been appointed, which will make a special study of the reconstructed relic. These remains are the first indisputable signs of palæolithic man to be found in central Asia, and previously no traces of the Mousterian culture had been known to occur there. The skull, it is stated, was found lying under a single stratum, close to the wall of the cave, while the remainder of the skeleton lay scattered beside it. The remains are those of a child of about eight years of age; and as it is in a fair state of preservation, it is possible to decide that it differs markedly in structure from the human skeleton of to-day. The contour of the skull, particularly, is said to recall that of the anthropoid ape—a statement which, at first sight, seems to conflict with the further comment that it is said to refute the racial theory that present-day man developed independently of Neanderthal man. The trend of recent discovery, it may be pointed out, would certainly not necessarily be widely at variance with modernistic tendencies in a skull of such a facies, but until further details are to hand judgment one way or the other is obviously premature.

Introduction of Screw Propulsion

AT a meeting of the Newcomen Society held at the Science Museum on April 19, in a paper entitled "The First Twenty Years of Screw Propulsion 1838–58", Engineer Captain E. C. Smith gave some interesting information regarding the early inventors of screw propellers, Sir Francis Pettit Smith, John Ericsson, George Lowe, George Blaxland and Bennet Woodcroft, whose names were most closely associated in the minds of their contemporaries with the early trials of sea-going screw-driven vessels and the adoption of the screw-propeller on a wide scale. It was appropriate, Capt. Smith said, that the subject should be dealt with at a meeting at the Science Museum, for Bennet Woodcroft was the virtual founder of that institution, while Smith was for some fourteen years the curator under Woodcroft. Both these pioneers were buried in Brompton Cemetery, and their tombstones mention their participation in the introduction of the screw. Ericsson's work began with his patent of July 1836, the building of the little *Francis B. Ogden* and then the slightly larger *Robert F. Stockton*. Soon after the trials of the latter in the Thames in 1839, she was sailed to America; Ericsson soon followed her and it was in the United States that his main work in connexion with screw propulsion was done, his most notable vessel being the U.S.S. *Princeton*, built in 1841–43. She was the first screw-driven warship ever launched. By 1850, about a hundred and fifty American vessels had been fitted with the screw. The most important work in England was done by Smith, but of this Capt. Smith is to deal with in a future paper. In an appendix to the paper prepared by Dr. H. W. Dickinson, Mr. A. A. Gomme and Mr. E. W. White, a review was given of the various law cases which arose out of the patents and over which a vast amount of time, energy and money were wasted.

Acquisitions at the British Museum (Natural History)

THE trustees of the Museum have purchased for the Department of Geology the terminal section of a tail-sheath of an extinct giant armadillo (*Hoplophorus* sp.) discovered in the Pleistocene deposits of Santa Fé, Argentine. The giant armadillos had a solid bony shell and armour of the same type on the head and tail. When danger threatened, they withdrew their limbs into the shell, closed the head end by means of the bony casque, and lashed the club-like tail from side to side so as to ward off attack from the rear. Some genera had massive horny spikes on the end of the tail, but in *Hoplophorus* the tail was covered with scales. The Department of Mineralogy has acquired a superb specimen of chessylite from Tsumeb in South-West Africa, and an extremely beautiful specimen with bright yellow plates of wulfenite (lead molybdate) on a glistening white ground of calcite crystals from Arizona. The Department has also purchased from the widow of the late Dr. A. E. H. Tutton a collection of the salts, chiefly double sulphates and selenates of the alkalis (potassium, rubidium, cæsium, etc.), utilized by Dr. Tutton in his researches on the relation between physical properties and chemical composition in isomorphous series of compounds. An important addition to the departmental library is a first edition of the "Speculum Lapidum" by Camillus Leonardus, physician to Cæsar Borgia, to whom the book is dedicated. It is a fine example of the printing press of Sessa in Venice. The book was one of the most widely read 'lapidaries' of the time, and its editions ran from the first in Latin in 1502 (forty-four years before Agricola's "De Natura Fossilium") to an English edition in 1750, bridging the gap between medieval and modern mineralogy. The late Frederick Adams of Jersey has bequeathed to the Department

of Botany a collection of 23,000 microscope slides of diatoms, together with catalogues, books and pamphlets, and the microscope with which he worked. For many years past Mr. Adams acquired whatever diatom collections came on the market, and thus accumulated the largest collection in private hands.

British Museum Excavations in Northern Syria

SOME further details of finds of the British Museum archæological expeditions to northern Syria under Sir Leonard Woolley and Mr. M. E. L. Mallowan in 1938 are given in the official summaries (*Brit. Museum Quarterly*, 13, 1; 1939). The most important objects found within the palace at Atchana, in the opinion of Sir Leonard Woolley, are the clay tablets inscribed in cuneiform in the Akkadian language, from which it has been possible to learn not only the name of the place—Alalakh—but also the names of several of its rulers. One of these was contemporary with Saushsatar, a king of Mitanni, already known as a leading potentate in western Asia in the middle of the fifteenth century B.C. Among the small objects the most interesting is a steatite roundel engraved on both surfaces with formal patterns surrounding a middle ring, which encloses characters of the Hittite hieroglyphic writing. At Tall Brak Mr. Mallowan found the great palace to be a building of Naram Sin of Agade, bricks being stamped with his name, and tablets being found of the Agade period of about 2500 B.C. The south-west corner of the palace proved to be built over the ruins of a great mud-brick tower, probably part of a temple, belonging to the Jemdet Nasr period, more than five hundred years earlier. It rested on a clay platform, under which was buried a great number of votive objects. Most of them were in underground chambers, which had been visited by robbers in antiquity. Apart from a large collection of beads, there were many amulets of two principal kinds, the first being stamp seals in the form of animals, or animal heads, and secondly little stone 'idols' found in large numbers, which though classed as amulets, are of unknown significance. They vary little in style; but some show as many as three pairs of eyes side by side, while one or two seem to portray mother and child. Many sherds of prehistoric painted ware were found, especially of the Tell Halaf style.

Recent Earthquakes

AN earthquake giving rise to large amplitudes on seismograms is reported by European observatories to have taken place on April 18, the initial waves being received about 6h. 36m. G.C.T. and the tremors lasting about three hours. The shock was well recorded at Stonyhurst, near Blackburn; at Kew, where it was received at 36m. 22s.; at Uccle, where it was received at 36m. 31s.; and at Zurich, where it was received at 36m. 18s. A very prominent feature of the seismograms at the latter three observatories was the S_eP_eS or SKS wave, which is a pulse starting at the epicentre as a transverse wave, being transformed at the earth's core to a longitudinal wave, continuing thus to the other side of the core where it is again changed back to a transverse wave. It is received as a transverse wave at the observatory. The epicentral distance of the shock from Uccle is calculated from the arrival times of the various pulses to be approximately 105°, which is consonant with an epicentre in Chile, though the azimuth has been difficult to determine, and confirmation or otherwise is awaited from the American observatories.

Two earth tremors are reported from Barbados to have been felt about 1.45 p.m. on April 20. At St. Kitts, several shocks were felt, though no damage is reported from the vicinity of either area. Tremors in the West Indies are by no means uncommon, and it will be recalled that the earthquake swarm which occurred in 1934 and 1935 in Montserrat led to the dispatch of an expedition to that island, and to consequent valuable reports by Mr. A. G. Macgregor and Dr. C. F. Powell. In September 1938 the Wiechert seismograph and eight Jagger shock recorders set up at the time of the expedition were still in operation on the island under the care of Mr. Kelsick. Then from August until November 1937 about forty shocks were reported from Dominica. The Royal Society afterwards nominated a West Indies Seismological Committee, which contemplated sending an expedition to this latter island. The shocks, however, diminished in frequency, and it is now wondered whether or not the centre of seismic activity in the islands has again changed.

Long-Distance Automatic Telephony

As improvements were made in manually operated switchboards, the trend of telephony has always been to substitute automatic devices for human labour. So much progress was made in this direction that it soon became obvious that even in large cities it would be possible to eliminate almost all the operators by the substitution of electrically controlled machinery. In the *Revue Générale de l'Electricite* of March 11, M. R. Dreyfus discusses the prospects of long-distance automatic telephony and points out that in small countries like Switzerland and Holland automatic inter-urban working is already in process of realization. It has now been developed to the extent of eliminating the operator at the exchange of the subscriber initiating a trunk call. By simply using his dial the subscriber puts himself in touch with any other subscriber in the same country. M. Dreyfus thinks it quite likely that automatic operation will now be developed for international calls. The International Consulting Committee for Long Distance Telephone Communication (the C.C.I.T.), which was formed by international delegates at a conference in Paris in 1923, has now taken up the problem. It is stated that within a few years a subscriber in Paris will be able merely by dialling to put himself through to a subscriber in New York.

Factory Lighting

THE spinning and twisting of real silk threads for the hosiery and silk weaving trade involves the processing of threads as small as two-thousandths of an

inch in diameter. The throwsters, that is, the operators who twist silk fibres into raw silk or raw silk into thread, find that they can work much better and much more quickly when the threads are brilliantly illuminated by the light from electric discharge lamps. To avoid eye strain, the Factories Act which came into force in July 1938 has emphasized the necessity for adequate lighting in such cases. We learn from an article on factory lighting which appeared in the *Electrician* of March 24, that G. H. Heath and Co. of Macclesfield and an associated company, British Crepe, Ltd., said to be the largest firm of silk throwsters in Great Britain, after experimenting with many kinds of lighting, have recently adopted as standard throughout their factories the electric discharge lamps made by Siemens Electric Lamps and Supplies, Ltd., with very successful results. In one case a room at the factory was lighted by discharge lamps consuming a total of 4·7 kw. and giving approximately 13–15 foot candles, whereas with gas-filled electric lamps the same room would have required 14·5 kw., that is, more than three times as much, and would only have given a lighting intensity of 7–8 foot candles. The sizes of the Siemens "QH" lamps installed are 80 w. and 125 w., according to the size and height of the rooms. The economy effected in running costs is very noticeable.

Compulsory Illumination in Factories

IN a special leaflet (Form 282) dated March 1939, the Factory Department of the Home Office reminds the owners of factories that the Departmental Committee appointed to deal with the subject has issued its fourth report (H.M. Stationery Office. 1*s.* 1*d.*) It recommends certain minimum standards of illumination below which work in factories should not be done regularly, and further recommends that these standards should be made legally compulsory next July. Tables of lighting practice suitable for many industrial processes can be obtained from the Illuminating Engineering Society, 32 Victoria Street, S.W.1. Another similar table is issued by the Electric Lamp Manufacturers Association, at Savoy Hill, W.C.1. The Secretary of State directs attention to a memorandum of the Air Raid Precautions Department, dealing with a general scheme of lighting restrictions to be enforced in the event of war. Occupiers of factories are recommended to obtain and study this memorandum, but naturally it deals more particularly with the screening of windows and roof lights in order to prevent the emission of light from buildings. It is in no way inconsistent with the requirement of adequate and suitable lighting within the building. Information and advice on general lines are usually obtainable from the gas or electricity undertaking supplying the factory.

Progress in Horticultural Science

VOL. 7 of *Scientific Horticulture*, the journal of the Horticultural Education Association (from the Hon. Editor, Mr. R. T. Pearl, S.E. Agric. Coll., Wye, Kent. 4*s.* net.; 4*s.* 6*d.* by post, February 1939) contains a well-balanced collection of papers for gardeners, both practical and professional. There are papers upon commercial horticulture in Eire, Devon, Lancashire and Bedfordshire, and articles upon the practical control of slugs by the use of 'Meta fuel', by S. G. Jary, and the horticultural work of the Land Settlement Association, by H. Fairbank. Messrs. H. G. H. Kearns and H. Martin contribute an account of the physical properties and practical use of combined insecticidal and fungicidal washes for use upon expanded blossom and foliage. They conclude that oil emulsions afford the most promising basis for combined direct and protective sprays, and practical instructions are given for their use upon various tree fruits and soft fruits. Interesting possibilities of the controlled nutrition of horticultural crops by growth in nutrient solutions are envisaged by Messrs. S. R. Mullard and R. H. Stoughton. Though the huge increases in yield claimed for the method in California were not realized in England, growth of gladioli was superior to that from soil-grown corms. Lela V. Barton summarizes the work of the Boyce-Thompson Institute, New York, upon germination and dormancy in seeds. Effective pre-treatments for dormant seeds and for the after-ripening of certain species, are condensed into three tables of great practical utility. Epicotyl dormancy, where the radicle begins growth but not the plumule, can be broken by keeping rooted seeds at a cool temperature, usually between 40° and 50° F. for a few weeks. A series of papers by members of the staff of the East Malling Research Station, on the occasion of the Association's annual conference in September 1938, is also included in the volume.

Radio Meteorology in the United States

THE growth of aviation has resulted in an urgent and intensive demand for accurate weather forecasting not only at ground-level but also at all heights now utilized by aircraft. Methods previously employed for determining aerological data in the atmosphere have utilized kites, sounding balloons or aeroplanes to carry special instruments recording the temperature, pressure and humidity at various altitudes. A mimeographed report entitled "The Radio-Telemeter and its Importance to Aviation", by R. W. Knight, has recently been circulated by the U.S. Civil Aeronautics Authority. This report discusses the general problem of determining aerological data by radio-sounding balloons, to which are attached transmitters emitting signals carrying the indications of the meteorological instruments. A somewhat detailed description is then given of the apparatus developed for this purpose by the Blue Hill Observatory of Harvard University. Illustrations are given of the complete radio transmitter, with the associated instruments for determining temperature, pressure and humidity. At the ground station, the signals are received on a simple pen-writing recorder, from which the aerological information can be observed while the balloon flight is in progress. A specimen record indicates that heights up to 72,000 ft. (14 miles) can be obtained by this type of apparatus. The U.S.

authorities maintain a network of teletypewriter communication facilities for disseminating the weather data to other meteorological stations, while radio broadcasting is used for the benefit of airmen. Plans are in hand for extending to other parts of the United States this application of radio methods to aerological observations.

Value of an Auxiliary Language

A PAPER by M. Talmey on the auxiliary language question, in which the value of an auxiliary language as an agency for world peace is discussed, has been reprinted from the *Modern Language Journal* of December 1938. Dr. Talmey discusses the basic requirements of an auxiliary language, particularly the importance of being more expressive than the natural languages and strictly neutral. It must also be as suitable for the expression of all ideas as the most efficient natural languages are. He discusses the development of Esperanto in the United States and the reasons for its failure, and then describes the origin and development of a new international system known as 'Arulo' or 'Gloro', which aims at removing the ambiguity which characterizes most modern languages. In this system the main parts of speech are recognizable by characteristic endings, of which there are eighteen, six occurring very rarely. He suggests that the fitness of a language for translation is the best criterion of its efficiency.

The School Health Services

A BOOKLET entitled "The School Health Services: their Initiation, Growth and Character" has been issued by the National Union of Teachers, Hamilton House, Mabledon Place, London, W.C.1. It is a review by the Union designed to show how the school health services came into being, how they have developed, and what part the National Union has taken in their initiation, conduct and progress. Provision of meals, medical and dental inspection and treatment, physical education and school camps are some of the subjects dealt with, and finally recommendations are put forward which it is considered would improve the services. The memorandum is primarily intended for the information of members of the Union, but has been issued to the public in the hope that it may prove of use to those concerned with the health and fitness of the children of the nation.

Oxford Science

THE second quarterly issue of this publication maintains the high standard and interest of the first number. There are two articles on the teaching of chemistry at Oxford, one by an undergraduate, the other by Dr. J. H. Wolfenden, the former deliberately critical and even fault-finding, the latter an admirable exposition and defence of the unique system of training that has been in force at Oxford during the past seventeen years. The possibilities of science as an education are discussed by Dr. J. Z. Young. He advocates means of making scientific courses more valuable as a part of general education so that whoever takes them may in some sense be educated and not, as too often at present, merely filled with plain facts. There are two articles on popular lines. Dr. A. H. Cooke of the Clarendon Laboratory gives a short account of the technique used there in attaining low temperatures and discusses briefly the more important results that have been obtained; Prof. J. H. Burn discusses the phrase 'suffering from blood-pressure' in a paper which will be read with interest by all and with relief by some. In "Correspondence" the Nuffield professor of clinical medicine criticizes some of the suggestions about the medical curriculum made by one of the medical tutors in an article in the first issue. There are also reviews of scientific books and short accounts of the activities of the scientific and medical undergraduate societies.

History of Cholera in Poland

IN his inaugural thesis (*Thèse de Paris*, 1938, No. 739) Dr. Kac Hirsz, a native of Warsaw, gives an interesting account of the history of cholera in his country, in which there were six epidemics of the disease between 1831 and 1902, the last of which persisted until 1915. The study of cholera epidemics in Poland as in the rest of Europe shows that they start in the East and then follow as a rule one of two routes, namely, (1) by land, passing through Astrakan and Russia, or (2) by sea, when they are conveyed by pilgrims coming from Mecca who had landed at Odessa. Since the first epidemic in 1831 all the countries in Western Europe have taken a lively interest in the behaviour of cholera in Poland and have actively collaborated with the Government of that country in a campaign against the disease.

Progress in Photochemistry

THE third report of the Committee on Photochemistry (Reprint and Circular Series of the National Research Council, No. 108, July 1938) contains eleven review articles dealing with various aspects of recent photochemical research written by seven different authors. Each is provided with a bibliography. There is a long table of quantum yields which gives a very useful review of this part of the subject. The report strikes a good balance between theory and experimental methods.

Large Sunspots

Two new large groups of sunspots have recently appeared. Particulars from the Royal Observatory, Greenwich, are as follows, the areas being measured on April 21 and expressed in millionths of the sun's visible hemisphere.

Date on Disk	Central Meridian Passage U.T.	Latitude	Area
April 20–May 2	April 26·1	27° N.	1050
April 20–May 2	April 26·6	16° S.	1350

Chromospheric activity in the region of the first group was noted on April 21, an extensive bright eruption beginning at $9^h\ 3^m$ and lasting for about half an hour.

The Night Sky in May

THE duration of night (sunset to sunrise) on May 1 in the latitude of London is 9·3 hours, decreasing to 7·8 by June 1. The moon is full on May 3 at $15{\cdot}3^h$, and new on May 19 at $4{\cdot}4^h$. A total eclipse of the moon, invisible from Great Britain, occurs on May 3. On May 5, the bright star β Scorpii (mag. 2·9) is occulted by the moon, the disappearance as seen from Greenwich taking place at $3^h\ 34{\cdot}5^m$ at position angle 164° from the north point. Lunar conjunctions with the planets occur as follows: on May $9^d\ 10^h$ with Mars; on May $14^d\ 23^h$ with Jupiter; on May $16^d\ 21^h$ with both Venus and Saturn; on May $17^d\ 14^h$ with Mercury. Venus, Jupiter and Saturn are morning stars. Mars rises about an hour after midnight at the beginning of the month and just before midnight at the end. Mercury is not visible either as a morning or evening star. On May 12 at about $3^h\ 45^m$ it is worth looking at Jupiter when satellites I, II and IV present a curious arrangement on the east side of the planet. A corrected ephemeris for Comet Pons Winnecke (1939 *c*) is given in I.A.U. *Circular* No. 758. On May 17, the ephemeris places the comet 6° greater in declination than the star β Boötis. No ephemeris is available here for the bright comet, Comet Hassel, discovered on April 18 in the constellation of Andromeda. Solar activity is sufficiently high to warrant a look-out to be kept for auroras. (All times are given in Universal Time; add 1^h to convert to Summer Time.)

Announcements

THE first superintendent of the new Engineering Research Establishment in Australia (see p. 697) is Mr. L. P. Coombes, formerly senior scientific assistant of the Royal Aircraft Establishment, Farnborough, where he was in charge of the aeroplane experimental tank.

PROF. GUSTAVE ROUSSY, professor of pathological anatomy in the University of Paris, has been elected a free academician of the Paris Academy of Sciences in succession to the late Paul Helbronner.

THE Makdougall-Brisbane Prize of the Royal Society of Edinburgh for the period 1934–1938 has been awarded to Prof. D. M. S. Watson, for his paper published in the *Transactions* of the Society, within the period, entitled "On *Rhamphodopsis*, a Ptyctodont from the Middle Old Red Sandstone of Scotland", and for his many distinguished contributions to the science of vertebrate palæontology.

THE International Congress of the Latin Federation of Eugenics will be held at Bucharest next September under the presidency of Prof. C. Parhon, when the subjects for discussion, among others, will be: (1) prophylaxis of hereditary diseases, (2) heredity and liability to infections, (3) inheritance of intellectual aptitudes, and (4) heredity and endocrinology.

THE annual Congress of the Royal Institute of Public Health and Hygiene will be held at Hastings on May 23–27 under the presidency of the Right Hon. Walter Elliot, Minister of Health. The Congress will consist of five sections, in which the following subjects will be discussed: Section I, State medicine and industrial hygiene; Section II, women and children and the public health; Section III, tuberculosis; Section IV, rheumatism and allied diseases; Section V, nutrition and physical education.

FARMERS and all interested in agriculture in its practical, technical, or educational aspects are invited to visit the Rothamsted and Woburn plots at any convenient time between the beginning of May and the end of October. Mr. H. V. Garner and Capt. E. H. Gregory will be in charge of the demonstrations. There is ample material at each farm to occupy a full day, and therefore visitors should arrange to see them on separate days. The director, Sir John Russell, will be happy to arrange full details with organizations of farmers, farm workers and others wishing to accept this invitation; small groups of farmers are specially welcomed. Further information can be obtained from the Secretary, Rothamsted Experimental Station, Harpenden.

A NATIONAL conference on Maternity and Child Welfare will be held at the British Medical Association House, Tavistock Square, W.C.1, on June 27–29 under the presidency of Mr. Walter Elliott, the Minister of Health, when the following subjects will be discussed: safety in childbirth for mother and child; encouragement of breast-feeding; the nursery school, nursery class and the day nursery; the child in relation to foster mother and the daily minder; parents with a physically defective child, and propaganda on the maternity and child welfare movement. Further information can be obtained from the Secretary, National Association of Maternity and Child Welfare Centres, Carnegie House, Piccadilly, W.1.

WE have received an annotated catalogue of works on chemistry, pure and applied, No. 857, from Messrs. Henry Sotheran, Ltd., 2–5 Sackville Street, London, W.1. This contains a large number of interesting items, and in most cases each work has a note of bibliographical, biographical or scientific interest. The catalogue is one of considerable interest and is valuable for the large amount of accurate information it contains.

RECENT statistics show that infantile mortality in Germany, though continually falling, is greater than that in some other countries including the United States.

WE regret that in the issue of NATURE of February 25, p. 329, it was stated incorrectly that Prof. Helmuth Scheel had been appointed president and Prof. Theodor Vahlen vice-president of the Prussian Academy of Sciences; Prof. Vahlen has been appointed president and Prof. Heymann vice-president, with Prof. Scheel as director of the Academy.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 727.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Surface Transport in Liquid Helium II

IN our previous communications[1] on the 'transfer' of liquid helium II by a surface film above the liquid level, we stressed the similarity of this 'transfer' with the so-called transport phenomena in the free liquid, and suggested that the latter might be due to a process similar to the transfer above the liquid level. Later experiments on the formation of this film[2] seemed further to strengthen the conception that there existed a similar surface transport below the liquid level, and we have recently made two observations which seem to corroborate this hypothesis:

(*a*) A small Dewar vessel (see Fig. 1) containing a heating coil was suspended by a thread in a bath of liquid helium II. When no heat was supplied, the levels of the liquid both inside and outside the vessel adjusted themselves to the same height L_1, owing to the 'transfer' through the film on the interconnecting glass surface. When, however, a current was passed through the heating coil, the level of the liquid inside the vessel *rose* above the outside level and took up an equilibrium position L_2. By increasing the connecting surface between the vessel and bath by a number of wires, differences between inside and outside levels up to 5 mm. could be obtained. This clearly shows that there exists a 'transfer' of helium from a colder to a hotter place when a temperature

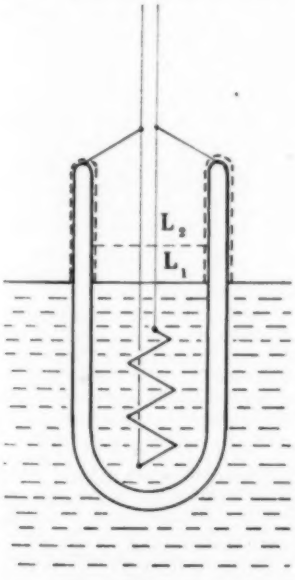


Fig. 1.

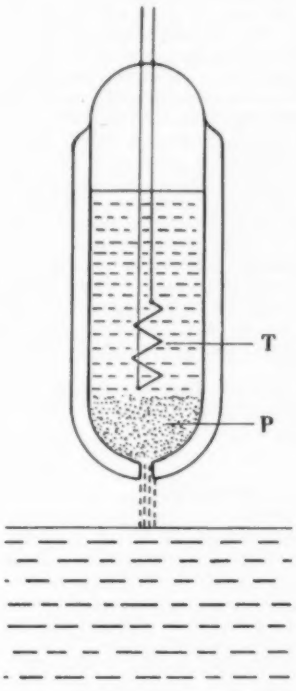


Fig. 2.

gradient is imposed. On further increasing the heat supplied, however, the evaporation from the vessel became the predominant factor and the inside level fell below that of the bath.

This effect is quite analogous to the 'fountain phenomenon' in the bulk liquid, discovered by Allen and Jones[3]. However, in the present case the transfer of liquid must be carried out through the surface film above the liquid level, which shows that there exists a flow of helium against a temperature gradient, even if the two containers are not connected by free liquid. One may conclude therefore that the 'fountain phenomenon' in the bulk liquid is probably also due to a surface transfer, though in this case along the surface below the liquid level. This hypothesis is further strengthened by the fact that the 'fountain phenomenon' is more pronounced when tubes containing fine powder are used to connect the two volumes of liquid rather than a straight capillary, for which the available surface is comparatively small[4].

(*b*) A Dewar vessel (see Fig. 2) was closed at the top and had a hole at the lower end which was constricted by a plug, *P*, of fine emery powder. It contained a phosphor-bronze thermometer, *T*, and was suspended in a bath of liquid helium II. When the Dewar vessel was lifted out of the bath, the liquid ran rapidly out of the vessel through *P* and fell into the bath, and at the same time the temperature of the inside liquid was noticed to rise by about 0·01°. On lowering the vessel so that now liquid ran from the bath into the vessel, the liquid inside was cooled by a similar amount.

This mechano-caloric effect is evidently the reverse of the 'fountain phenomenon', for whereas the latter means that the setting up of a temperature difference results in a flow of liquid helium II, the mechano-caloric effect shows that a flow of liquid helium II is accompanied by a development of heat (or cold). Such a caloric effect has actually been postulated by Tisza[5] for a flow of liquid helium II through capillaries. It seems to us, however, that the anomalous phenomena of liquid helium II are not so much caused by capillary flow as by a transport along solid surfaces; and these results seem to indicate that the heat content of those atoms transported by surface flow must be lower than average. The hypothesis that the transport phenomena in the bulk liquid are due (at least primarily) to a surface transport similar to the 'transfer' above the liquid level seems also to agree with observations by Allen and Misener[6] and H. London[7], as well as with theoretical considerations of F. London[8].

A more detailed discussion of this tentative explanation with regard to these and other results will be given elsewhere.

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[2] To be published shortly.
[3] Allen and Jones, NATURE, **141**, 243 (1938).
[4] Allen and Reekie, *Proc. Camb. Phil. Soc.*, **35**, 114 (1939).
[5] Tisza, NATURE, **141**, 913 (1938); *C.R.*, **207**, 1186 (1938).
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A New Refraction Method for Obtaining Photographic Records of Concentration Gradients

WHEN a concentration gradient in a vertical column of solution, for example, an ultracentrifuge cell, is investigated by a refraction method, it is desirable to obtain a diagram relating the refractive index gradient with height in the column of solution. The two data, the height and the corresponding gradient, are in the different methods registered along the same vertical axis or along one vertical and one horizontal axis.

Using the scale method described by Lamm[1], which at the present time is far the most accurate procedure, we get the two data registered along the same vertical axis. This makes it necessary to compute the scale photographs before the shape of the curve and the exact positions of the maxima can be obtained. In the Toepler *Schlieren* method[2], where the two data are still registered along the same vertical axis, we can measure the positions of the maxima directly on the plate, but only a rough estimation of the shape of the curve is possible. The method worked out by Philpot[3] gives the height along a vertical axis and the gradient along a horizontal axis. The curve is in this case obtained as the boundary between dark and white on the plate. The shape of the curve may be seen directly on the plate, and the position of the maxima can be measured in a comparator. The method to be described in this communication gives the height along the horizontal axis and the gradient along the vertical axis. On the plate the curve appears as a rather narrow dark line (Fig. 1).

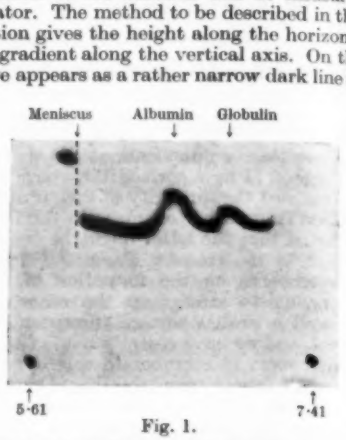

Fig. 1.

PHOTOGRAPHIC RECORD OF SEDIMENTATION IN DILUTE HORSE SERUM SHOWING THE ALBUMIN AND THE MAIN GLOBULIN COMPONENT.

Centrifugal force, 350,000 times gravity; time after reaching full speed, 50 min. Reference points and their distance (cm.) from axis of rotation are at foot of record.

Optical arrangements (Fig. 2). The light from an automobile head-lamp bulb with horizontal filament, *A*, passes through a spherical lens, *B*, placed at its focal distance from the lamp, and a cylindrical lens, *C*, with vertical axis, which concentrates the light on the centrifuge cell, *F*. *E* is a slit inclined at an angle θ to the vertical axis. The projection of the different points of the slit on a horizontal axis is focused on the photographic plate, *I*, by means of the cylindrical lens with vertical axis, *G*, and the spherical lens, *H*. Vertically the lens *H* still focuses the lamp *A* on to *I*. Conjugate foci are marked *a*, *a'* or *b*, *b'*.

If there is no deviation of light in the centrifuge cell, a horizontal straight line, *OX*, is obtained on the plate. The length, *X*, of this line corresponds to the cell-height, *h*, and the angle, θ, in the following manner:

$$X = h.m.\tan\theta, \qquad (1)$$

where *m* is an enlarging factor equal to the ratio between the focal distances of the lenses *H* and *G*.

If light is deviated by an angle δ (Fig. 2) at a certain height in the cell, the corresponding point of the line *OX* is displaced a distance Z_1 proportional to δ and the focal distance *f* of the lens *H*. We thus obtain the equation:

$$Z_1 = f.\delta \qquad (2)$$

The angle δ depends upon several conditions; for example, cell deformation, compression of the liquid, sedimentation of low-molecular and high-molecular substances. In order to obtain the effect caused by the sedimentation of the high-molecular substance under investigation, two similar runs are made: the reference run, with pure solvent in the cell, as well

as the normal run. A diagram with the differences, Z_2, between every two corresponding Z_1-values as ordinate and the position in the cell as abscissa gives the desired curve. Z_2, according to Lamm[1], is related to the cell thickness, a, and the refractive index gradient, dn/dx, as follows:

$$Z_2 = a.f.dn/dx \qquad (3)$$

As the slit angle θ does not enter into equation 3, it is possible to alter the sensitivity by changing θ. When there is a small gradient, θ is also reduced and the ratio between ordinate and abscissa scales becomes larger. For a large gradient the image is made as broad as possible by making θ large.

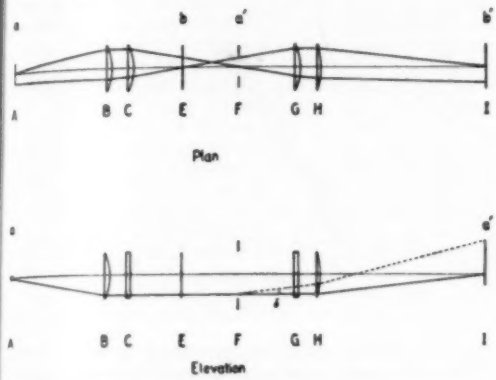

Fig. 2.

DIAGRAM OF OPTICAL ARRANGEMENT.

To obtain absolute Z_1 values, the position of the undeviated straight line OX must be recorded. In the ultracentrifuge practice this is easily arranged. The balancing cell in the rotor is provided with two index holes at distances from the axis of rotation that are smaller and greater respectively than that of the solution cell. The light passing the index holes is recorded on the plate as two points, called reference points (Fig. 1). For the calculations an enlarged image of the photograph is projected on to millimetre paper and a line is drawn in the middle of the curve. The position of the plate is adjusted to give the reference points at the same place on the millimetre paper in both the reference run and the normal run.

The optical arrangements are made in such a way that both the new method and the scale method can be used on the same run. The first use of the method has therefore been to get immediate information on the general shape of the sedimentation curve and for choosing scale distances in the scale exposures. In preliminary experiments the sedimentation constants and the concentrations of the sedimenting substances calculated according to the new method and the scale method have been found to agree satisfactorily.

In comparing this new procedure with Philpot's method there are two points worth considering. The fact that a line and not a boundary between dark and white is obtained on the photographic plate permits a more exact recording of the sedimentation curve than is possible with Philpot's method. Quite recently this disadvantage in Philpot's method has been overcome by Svensson[4]. With his arrangement a line is obtained, but it is still an open question whether his modification gives enough light intensity for use in the ultracentrifuge.

Furthermore, the use of the reference points makes it possible to obtain with the aid of a reference run a well-defined base-line. On the other hand, the possibility of changing the sensitivity is more adequate in Philpot's method than in the new one.

A more detailed description of the method and its accuracy will in the near future be given elsewhere.

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March 13.

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[2] Tiselius, A., Pedersen, K. O., and Eriksson-Quensel, I.-B., NATURE, **139**, 546 (1937).
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[4] Svensson, H., *Kolloid-Z.*, in the Press.

Deposition of Protein Multilayers

SEVERAL workers[1,2] have built up multilayers from proteins spread at the water-air interface, using some modification of Blodgett's technique[3], and drying the wet slide between each dip. It has sometimes been assumed that this procedure deposits a monolayer of protein on the slide at each movement of the piston and that the thickness of the resultant multilayer is a simple multiple of the thickness of the surface film of the protein on water, also that this thickness is a measure of the lengths of the side chains in the protein.

The area and presumably also the mean thickness of a protein film are dependent upon the piston pressure employed. At 30 dynes the area is about half the area at 10 dynes, and multilayers which we have deposited at high pressure have shown interference colours when only 40 layers thick, indicating that an average thickness of about 20 A. per layer can be obtained (see ref. 2) instead of the 10 A. that has been obtained by some other workers[1].

Mitchell[4] found that surface films of proteins go into solution readily and come out on clean portions of the surface if the pressure is near the collapse point. In his experiments, using the spreading technique of Gorter and Grendel[5], he found collapse points between 7·5 and 15 dynes for various proteins. The same effect has been found with egg albumin spread from the dry powder on distilled water with piston pressures as low as 10 dynes, the lowest at which we have been able to build up multilayers.

The wet slide on withdrawal after dipping contains water between the two upper layers of protein, as can be demonstrated by measuring the potential. Deposition of stable multilayers can readily be achieved on gauzes both of stretched silk and of metals. Using a 'slide' of stretched silk in electrolytic contact with the trough at its lower edge, the potential was measured with an ionized air electrode at the exposed surface of the partly withdrawn slide, at the air-liquid surface in direct proximity to the slide, and at a remote part of the trough. In one experiment, at 17 dynes, the undisturbed egg albumin had a potential of 310 mv.; near the slide, where the albumin had presumably been stretched, the potential was 270 mv.; and on the upper edge of the wet slide, 210 mv. The low value indicates that the protein had been considerably stretched as it went on to the 'slide', but that it had approximately the same orientation as on the water surface. There is no reason to assume that the hydrophilic

groups have turned over and that the water adheres on top of the film; in fact a small bubble of water can often be moved about within its protein sack by tilting the slide. If protein has dissolved in the substrate, some will be in solution in the water on the slide and will remain after drying, contributing to the mean thickness of the protein in the multilayer. This factor will contribute a large error if the dissolved protein is adsorbed beneath the surface layer.

The deposition ratio (the decrease in water surface covered by the protein divided by the area of the slide covered) was measured with egg albumin spread from a powder at piston pressures of 10 and 17 dynes. With new substrates of distilled water deposition ratios of 1·0 were sometimes obtained; but after a few minutes, especially if the surface was disturbed by dipping, the deposition ratio fell and values as low as 0·6 were sometimes obtained. At the same time, the protein commenced to go into solution and came out in the piston oil and on the clean surfaces of the trough. Low deposition ratios and solution of the film were always obtained at higher piston pressures.

It would seem advisable to have some slow mechanical dipping device and to empty and clean the trough between each dip while the film is drying in order to get deposition ratios of 1·0 and no contamination from dissolved proteins. If these precautions are not observed, no valid estimate of the thickness of a surface layer of protein at a given pressure can be obtained from measurements on multilayers.

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Viscosity of Liquids

As a result of a detailed consideration of the mechanism of viscosity of liquids, Fig. 1 was obtained. It is a graph of the logarithm of viscosity of the *n*-paraffin hydrocarbons from *n*-butane to *n*-octadecane (represented by the figures opposite the respective points), against the function T_B/T, or the absolute boiling temperature/absolute temperature of measurement.

It may be seen from the graph that:

(1) A 'specific viscosity curve' is obtained for a family of compounds irrespective of the position of the compound in the family, provided it is not among the first few members.

(2) The function T_B/T thus becomes a fundamental basis for comparing a dynamic property such as viscosity when the effects of constitution are to be studied. It has been pointed out[1] that the reduced temperature T/T_c and the function $\frac{T - T_f}{T_c - T_f}$, in which T_c is the critical temperature and T_f is the freezing temperature[2], failed to yield results of any value when dealing with viscosity.

(3) It is generally accepted that in $\eta = Ae^{B/T}$, B is invariant with temperature for such liquids. This statement cannot be proved rigorously unless a liquid is examined over the entire range of temperature in which it exists as such.

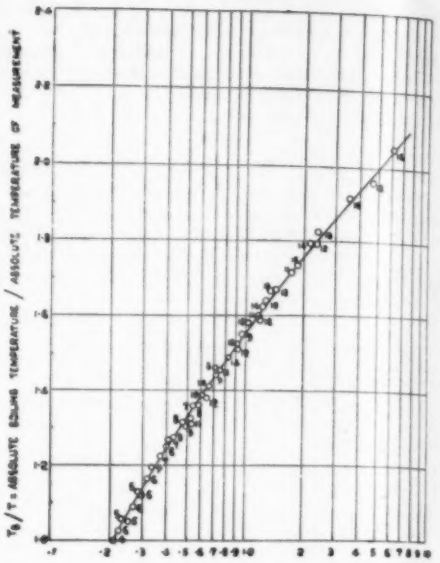

Fig. 1.

In this graph, none of the liquids has been so examined since the literature generally reports the results at temperatures between 0° and 100° C. Since *n*-butane boils around 0° C. and *n*-octadecane is solid at that temperature, it may be seen that this graph actually represents the viscosity of any one of these *n*-paraffins over the entire range in which it exists as a liquid. The line is not straight and, therefore,

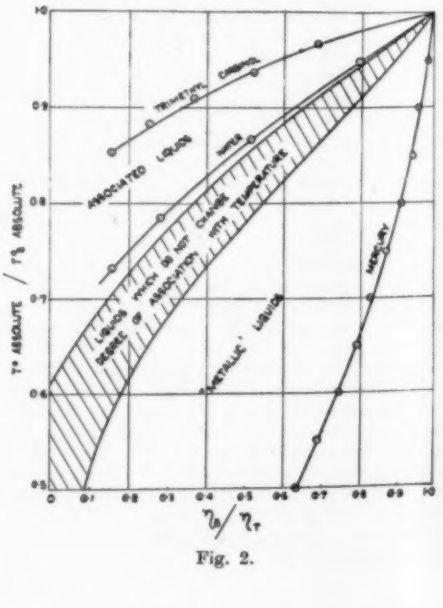

Fig. 2.

or all these members B is variable with temperature. It probably follows that for all liquids B is a function of temperature, and that the difference between associated and non-associated liquids with regard to B is entirely a matter of degree.

For other families of compounds similar lines exist, but a better rendering of these curves is obtained by plotting the function η_B/η_T against T/T_B, as shown in Fig. 2.

The results of 137 liquids have been plotted representing *n*-paraffins (12), *iso*-paraffins (15), acyclic olefines (7), *cyclo*-hexene, alkyl halides (25), alcohols (11), acetaldehyde, ketones (4), anhydrides (2), diethyl-ether, carboxylic acids (5), water, cyclic compounds (30), elements (12) and inorganic compounds (10), resulting in the following conclusions:

(1) All the normal or unassociated liquids fall in a fan-shaped manner in the shaded portion of the graph. In this area, also, fall such compounds as the carboxylic acids which are known not to change appreciably the degree of association on rise of temperature and in fact evaporate to a great extent in the dimer form. Thus the shaded portion contains all compounds which are either unassociated, or if associated, have a small coefficient for the increase of association with a fall in temperature.

(2) The upper portion of the graph contains associated liquids. It is remarkable that water changes its degree of association very slowly, as the evidence of the plot tends to show, when compared with trimethyl carbinol.

(3) The lower portion of the graph is characteristic of liquid metals. Mercury shows the regularity of the points on the curve.

A full description of the work and the results obtained has been prepared for publication and will appear in the literature later in this year.

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Surface Tension and Lindemann Frequency

ANDRADE[1] has derived the expression $\eta = \frac{4}{3}\frac{m\nu}{\sigma}$ for the viscosity (η) of a liquid at its melting point in terms of the molecular mass (m), the Lindemann frequency (ν) and the mean molecular distance (σ). This simple relation has been amply substantiated by experimental results and has given us an insight into the mechanism of viscosity in liquids. But so far as we are aware, no equally elegant explanation of the phenomenon of surface tension in liquids has been put forward.

Let us assume that at the melting point the energy per unit area of the surface is given by the total energy of the molecules in a surface layer of unit area, each molecule vibrating with a frequency equal to the Lindemann frequency. Considering that the oscillation is simple harmonic with an amplitude a, it follows on the basis of the assumptions that the surface tension

$$\gamma = \Sigma\tfrac{1}{2}ma^2(2\pi\nu)^2 = \frac{2\pi^2a^2}{\sigma^2}\,m\nu^2.$$

Assuming, after Lindemann and others, that at the melting point a/σ is constant, we obtain

$$\nu = k\sqrt{\frac{\gamma}{m}},$$

a relation dimensionally correct. Calculating the Lindemann frequency both for elements and compounds from the relation $\nu = 2{\cdot}80 \times 10^{12}\sqrt{T_s/MV^{2/3}}$ where T_s is the melting point, and M and V refer to the atomic weight and the atomic volume respectively in the case of elements, and to the molecular weight and the molecular volume respectively in the case of compounds[2], and dividing the frequency so obtained by $\sqrt{\gamma/m}$, we find that the value of k in the case of forty-six substances examined, of which twenty-four are elements, ranges between 1 and 3·5, with a mean value of 2·34. The variation of surface tension with temperature can thus be explained on the same lines as that of viscosity.

Details will be published elsewhere.

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Influence of Electrical Conductivity of Surroundings on the Natural Wave-length of an Antenna

THE free end of an antenna fed by an oscillator is connected to a metal plate under which is placed a basin of water. The conductivity of the water is changed by adding known weights of various salts. The solution is earthed and the distance between the plate and the solution is kept constant.

It has been found that the natural wave-length of the antenna increases with this conductivity up to a definite limit and then becomes constant for greater concentrations. This definite concentration marks the limit between the dielectric and the conductive state of the solution. The increase of the natural wave-length for small concentrations can be attributed to the fact that the dielectric constant of the solution increases with concentration.

Experiments are now being carried out for different wave-lengths and different electrolytes. The effect of this conductivity on the resistance of the antenna is also being investigated.

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Hydrolytic De-amination of Amino-Acids

Virtanen and Erkama[1] discovered recently in *B. fluorescens liquefaciens* an enzyme which causes hydrolysis of aspartic acid into malic acid and ammonia. This, however, is not the first example of hydrolytic de-amination of amino-acids. In a series of papers[2], we have been able to show that in aqueous solution, amino-acids are hydrolysed under the

influence of ultra-violet light to give the corresponding hydroxy-acids:

$$R.CH(NH_2).COOH \rightarrow R.CH(OH).COOH.$$

Here again, a certain resemblance exists between enzymatic and photochemical processes.

This photolysis of amino-acids is a general reaction. It is the primary process in absence of oxygen and precedes, therefore, the well-known photo-oxidation of amino-acids[2] into the corresponding aldehydes:

$$R.CH(NH_2).COOH \rightarrow R.CHO.$$

Histidin, for example, is reported by Szendrö[4] to give imidazol-acetaldehyde, on irradiation. We have been able to show that here, too, ammonia and a hydroxy-acid are formed primarily; the presence of the latter one is easily demonstrated by the colour reaction with 2.7 dihydroxy-naphthalene[5]. The reaction velocity is high: 115 c.c. of a 1 per cent aqueous solution of (-)-histidin, irradiated for two hours in the apparatus, described previously, gave 18·4 c.c. of $N/10$ ammonia, corresponding to a 25 per cent decomposition of histidin in the above sense. In presence of oxygen only, the hydroxy-acid is degraded into imidazol-acetaldehyde.

The histamin-like biological effects of an irradiated histidin solution[6] are due to imidazol-acetaldehyde according to Szendrö[4], and there is no need to assume a photolytic degradation of histidin into histamin proper. As imidazol-acetaldehyde resembles histamin physiologically, the possibility has to be kept in mind that the "histamin-precursor" identified by Barsoum and Smirk[7] with histamin on the basis of their biological resemblance is also imidazol-acetaldehyde.

It would be worth while to test the biological effects of imidazol-hydroxy-propionic acid.

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March 23.

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[7] *Clin. Sci.*, 2, 337 (1936).

Sulphonamide Drugs and Pneumococcus Capsular Polysaccharides

THE remarkable curative effects on certain types of bacterial infection of drugs of the sulphonamide group[1] immediately opens up a new field of research into the mode of action of these drugs. In a bacteriological examination of organisms isolated from the peritoneal cavity during a course of treatment of an experimental pneumococcal infection in mice by 'M and B 693' (2-[*p*-aminobenzenesulphonamido]-pyridine), Whitby[2] reported that the "capsules became swollen and crenated and eventually disappeared". Hence it might seem that the drug has a direct destructive action on the pneumococcus polysaccharide-capsular material. It is well known that the capsule is a defence mechanism of virulent bacteria and, for example, in pneumococcal infections, is probably the decisive factor in determining the fate of the bacteria in the host. Any destructive action on capsular material by sulphonamide drugs would be comparable to the effects of the polysaccharide-splitting enzymes studied by Avery, Dubos and others[3]. In this work it has been clearly demonstrated that denudation of the organism of its capsule leaves the cell exposed to the phagocytic action of the body and usually the attack of pneumonia is repelled.

We have thought it of interest to ascertain whether solutions of sulphonamide drugs have any destructive action *in vitro* on purified capsular polysaccharides from Type I and Type II pneumococcus. Accordingly dilute solutions of the polysaccharides were separately incubated in physiological saline during several days at body temperature, with saturated solutions of sulphonamide, sulphonilamide (supplied by the Glaxo Laboratories, Ltd.) and 'M and B 693' (supplied by Messrs. May and Baker, Ltd.). The solutions were systematically examined for changes in specific rotation, increase in reducing power, change in viscosity and for loss in precipitin reactivity with homologous immune antisera.

We could clearly demonstrate that under the above conditions the drugs have no chemical action on the specific polysaccharides. It is likely, therefore, that the action of the drugs *in vivo* is not one of capsule destruction but one of capsule inhibition. Whilst this work was in progress, a recent investigation by McIntosh and Whitby[4] has thrown considerable light on the problem. These authors favour the idea that the mode of action of the drugs is in some measure bound up with the inactivation of the bacterial enzymes responsible for the food requirements of the organisms. In support and extension of these findings it is of interest to recall the work carried out in this department and elsewhere[5] on polysaccharide synthesis by bacteria. In the cases studied here it has been found that polysaccharide production is extremely capricious, for not only must the organisms have their appropriate food supply but a highly specific 'accessory growth factor', albeit in minute quantity, must also be available. It is possible that *in vivo* sulphonamide drugs can render unavailable to the organism the necessary 'accessory growth factor' and thus inhibit capsule formation; the body would then be able to rid itself of the invading bacteria by phagocytic action.

This tentative explanation would account for differences observed in the mode of action of various drugs on different groups of organisms, since 'accessory growth factors' are sharply specific for each group. A search in peptone broth or in blood for such growth-substances responsible for capsule production in the pneumococcus group, for example, might well prove a profitable study.

M. STACEY.
E. SCHLÜCHTERER.

A. E. Hills Laboratories,
University,
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March 23.

[1] Whitby, L. E. H., *Lancet*, 235, 6011 (1938).
[2] Whitby, L. E. H., *Lancet*, 235, 1210 (1938).
[3] White, B., "The Biology of Pneumococcus", chap. ix.
[4] McIntosh, J., and Whitby, L. E. H., *Lancet*, 235, 431 (1939).
[5] Hucker and Pederson, *Cent. Bact.*, II, 85, 65 (1931). Allison and Hoover, *J. Bact.*, 27, 561 (1934). Thorne and Walker, *Proc. Iowa Acad. Sci.*, 41, 63 (1934). Carruthers and Cooper, *Biochem. J.*, 30, 1001 (1936). Stacey and Youd, *Biochem. J.*, 32, 1943 (1938).

Sulphanilamide Therapy in Pneumonia

NICOTINIC acid has been found to be especially important as a supplement to sulphanilamide therapy of pneumonia. In a series of cases, it has been noted that there frequently occurs in victims of pneumonia treated with sulphanilamide, a black-dotted, heavy furring of the tongue akin to black-tongue. At the same time, consolidation of the lung fails to resolve though the temperature be normal and toxic effects cleared.

Administration of nicotinic acid in doses of 10–100 mgm. results in rapid clearing of the tongue, generally from behind forward. At the same time, the consolidation of the lung resolves.

Though no pathological studies have been made, it appears probable that the failure of resolution in these cases is due to changes in the mucous membrane of the bronchial tree of the same character as affects the tongue.

An interesting light is thrown on the mechanism of action of sulphanilamide by the change of typing of the pneumococci in cases treated with the drug. Following therapy, it will frequently be found that the pneumococci lose their typing reactions and cannot be typed. Characteristic typing reactions are usually restored to the organisms after animal passage.

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March 6.

"Animal Language"

THERE is a point in the review of "Animal Language" in NATURE of February 25 on which I should like to comment. The reviewer writes: "At times, Dr. Huxley expresses his views with considerable confidence. 'What is the point of a rattlesnake's rattling? The answer is really very simple. The snake doesn't want to strike unless it has to. It might very easily get trodden on . . . The rattle is a warning to the intruder to keep away. . . . In the same sort of way those who install burglar alarms in their houses put up a notice to that effect outside.' This may be so, but whether it is an established truth or simply an *ad hoc* hypothesis we are given no real evidence to decide."

In the first place, "Animal Language" was not designed as a scientific monograph, but as a popular book addressed to the general public, so that citations of evidence would have been out of place. In passing, in compiling it I was astonished at the lack of any coherent body of scientific information on the comparative aspect either of sound-production or of hearing: here is a fruitful field for anybody with time and knowledge.

As regards the point concerning the rattlesnake, Gadow, in the "Cambridge Natural History", writes: "The rattle is decidedly useful to the snake as an instrument of warning off any approaching possible enemy, since no snake likes to bite unless in self-defence or in order to kill its prey." The "Encyclopædia Britannica" (eleventh edition) expresses a similar idea. So does that eminent authority, Dr. Thomas Barbour, in his book "Reptiles and Amphibians" (1926), but in considerably greater detail, and with the specific suggestion that the bison is the enemy to be warned off.

Ditmars, in his "Reptiles of the World" (1910), is one of the few authorities to express scepticism as to the rattle's warning function—though he goes on to make the far more speculative statement that it may serve as a mating call, an assertion which, as Barbour points out, must be erroneous as snakes cannot hear.

The whole question of what constitutes "evidence" for the presumed function of an allæsthetic character, whether concerned with warning, threat, or display, is a very interesting one. I have recently[1] briefly discussed this question. It seems clear that there are different degrees of probability, culminating in proof only when the experimental method has been applied, but that the 'old-fashioned' Darwinian view of presuming an adaptive function from general study of the structure and habits of the animal in question gives a reasonable probability and puts the onus of disproof on opponents.

Ditmars indulges in one fallacy that is so common that I cannot refrain from commenting upon it. He wishes to deny the warning function of the rattle because "many species of harmless and poisonous snakes without a rattle, vibrate their tail when angered". It should surely be obvious by this time that the lack of a character or organ in one type does not preclude its being adaptively functional in another. Numerous examples of this point in regard to threat and warning characters in birds have recently been given by me[2]. Not only this, but in this particular case the evidence adduced by Ditmars strengthens the case for the warning function of the rattle, by making it clear that tail-vibration *per se* is a warning device, presumably rendering the snakes more conspicuous without impairing their capacity to strike. In some cases it may produce auditory as well as visual effects, by rustling dry leaves on the ground. The rattle is a further auditory specialization of this widespread generalized activity.

JULIAN S. HUXLEY.

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March 21.

[1] "Evolution" (Oxford, 1938); and *Amer. Nat.*, **72**, 416.
[2] *Proc. Eighth Internat. Ornith. Congr.*, p. 430.

Production of Intercellular Hormones

IN the investigation of metabolic controlling factors (intercellular hormones) appearing in the suspending fluid when cell aggregates are subjected to lethal ultra-violet[1], X-rays[2], and other external agents, it seems to us of particular interest to determine whether such substances are released by living cells into the intercellular fluids or are simply dead-cell disintegration products. To study this question, suspensions of yeast in isotonic salt solution were irradiated with lethal ultra-violet for periods from 9 to 24 hours under such conditions that the full irradiation period was required to kill 90 per cent of the cells. Samples taken out at regular intervals were filtered through Berkefeld filters, and the growth potencies of the filtrates compared with those of filtrates from control suspensions allowed to stand for equal periods without irradiation. The extent of killing was determined by methylene blue staining and by plating. Maximum production of growth factors (intercellular wound hormones) preceded maximum rate of killing and occurred while most of the cells were still living.

As an alternative method, carbon dioxide and oxygen were bubbled through yeast suspensions for 24- and 48-hour periods, and the growth potencies

of the filtrates from these suspensions compared with those from controls allowed to stand for equivalent periods. Less than one per cent of the cells stained in any of these suspensions. Nevertheless, the filtrates from the suspensions exposed to carbon dioxide averaged one and one-half times as potent as the control filtrates, and four to seven times as potent as the filtrates from suspensions exposed to oxygen.

Full details will be published elsewhere.

JOHN R. LOOFBOUROW.
SISTER CECELIA MARIE DWYER.

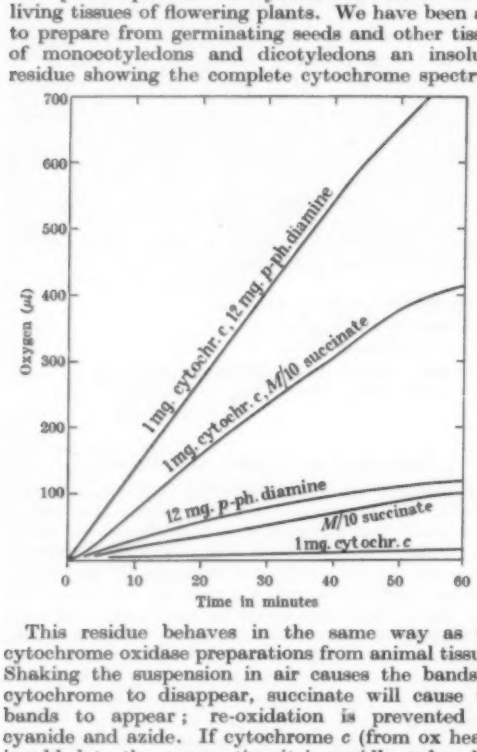
Institutum Divi Thomæ,
Cincinnati, Ohio. March 7.

[1] Fardon, Norris, Loofbourow and Ruddy, NATURE, **139**, 589 (1937); Sperti, Loofbourow and Dwyer, NATURE, **140**, 643 (1937); *Studies Inst. Divi Thomæ*, 1, 163 (1937); Loofbourow, Dwyer and Morgan, *Studies Inst. Divi Thomæ*, **2**, 137 (1938).

[2] Fardon, Carroll and Ruddy, *Studies Inst. Divi Thomæ*, 1, 17 (1937)

Cytochrome Oxidase in Flowering Plants

IN 1925, Keilin[1] described for the first time the absorption spectrum of cytochrome visible in the living tissues of flowering plants. We have been able to prepare from germinating seeds and other tissues of monocotyledons and dicotyledons an insoluble residue showing the complete cytochrome spectrum.



This residue behaves in the same way as the cytochrome oxidase preparations from animal tissues. Shaking the suspension in air causes the bands of cytochrome to disappear, succinate will cause the bands to appear; re-oxidation is prevented by cyanide and azide. If cytochrome *c* (from ox heart) is added to the preparation it is rapidly reduced in presence of succinate and immediately oxidized by shaking in air. In the accompanying graph are shown manometric measurements of the oxygen uptake of the preparation in presence of cytochrome *c*, succinate and *p*-phenylenediamine. The enzyme suspension was prepared by grinding cotyledons from germinating *Phaseolus* seeds in twice their weight of water; the greater part of the solid material was removed by a low-speed centrifuge and the opalescent fluid was spun down on a high-speed centrifuge. The slightly brownish residue was suspended in about three volumes of water. This preparation showed a cytochrome spectrum one twentieth the intensity of that in bakers' yeast. In each experiment shown 37·5 mgm. dry weight were used in 2·2 c.c. of fluid at *p*H 7·4. The Q_{O_2} with *p*-phenylenediamine and cytochrome *c* was 20; with succinate and cytochrome *c*, 10·8. Tests for catechol oxidase were negative.

These results show that the cytochrome spectrum seen in plant tissues is associated with the insoluble enzyme systems which characterize yeast and animal tissues. This now proves the presence of a true cytochrome oxidase in the higher plants and a respiratory mechanism identical with that found in yeast and animals. It is not possible to state exactly how much of the oxygen taken up in the respiration of plants is by means of the cytochrome system, but in some tissues the intensity of the spectrum when compared with that of yeast is parallel with the rate of respiration. These observations are a confirmation of the general presence of the cytochrome system in aerobic organisms as originally discovered by Keilin.

R. HILL.
K. BHAGVAT.

School of Biochemistry,
Cambridge. March 24.

[1] Keilin, D., *Proc. Roy. Soc.*, B, **98**, 312 (1925).

Spectroscopic Power of a Human Eye due to Injury

THE case reported here of a structure resulting from an injury to an eye, conferring on the owner the power of spectroscopically analysing light, is possibly unique.

Mr. J. M. Rowe, of Adelaide, suffered, at eighteen years of age (he is now fifty-two years old), an injury to his right eye due to the impact of a stone-chip, which cut through the cornea and iris, but did not, apparently, penetrate further. Natural healing took place with development of a scar on the cornea the protuberant part of which was afterwards removed with a pair of surgical scissors. The pupil of the eye was left, however, displaced from its central position downwards and inwards; also it is no longer round but distinctly elliptical in shape with its long axis in the direction of the displacement. Eyesight with this eye is quite normal—Mr. Rowe has been an excellent rifle-shot—except for the fact that bright sources of light show spectral colours. Mr. Rowe has been aware of this for some years, but only recently informed me of this peculiarity of vision.

Tests made showed that the effect is due to the existence of a periodic structure in the eye of the nature of a diffraction grating. It is definitely *not* a prism effect since: (1) the spectrum is seen on either side of the bright source; (2) the blue is on the inside, the red on the outside of these images; (3) the angle made by the direction of the blue light with that of the source is approximately half that made by the red part of the coloured image. Rough measurement of these angles was made by asking Mr. Rowe to indicate the positions of the several images on a metre rule held at a measured distance from the eye. The blue—or violet—inner edge of the coloured images was approximately four and a half centimetres distant from the central source, a single filament galvanometer lamp; the red outer edge about 7 centimetres, when the metre rule was held at a distance of one metre from the eye. This makes the first-order diffraction angle about 2½° for the blue, and about 4° for the red light, corresponding to a spacing in the elements which constitute the grating

of 1,000–1,300 'lines' per centimetre. The direction in which the rule had to be placed in order that all three images fell upon it was about 15° from the vertical and, roughly at least, perpendicular to the direction in which lay the major axis of the displaced pupil.

A sodium lamp gave first-order (uncoloured) images in positions agreeing well with the above. Second-order images were seen only when a 'Pointolite' arc-lamp was substituted for the filament lamp, the brightness of the spectrum causing Mr. Rowe to exclaim : "Oh ! It's beautiful."

Dr. Tostevin, an eye-specialist, kindly made an examination of Mr. Rowe's eye with the aid of a slit-lamp. He states that the injury has resulted in adhesion of the cornea to the iris, and that the cells of the cornea where the scar exists have lost their nuclei and are elongated in a definite direction. There is no injury to the lens.

Should any reader of NATURE suggest a reason for more accurate or other observations, Mr. Rowe has intimated his willingness to submit to them.

KERR GRANT.

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Feb. 27.

Commemoration of the Cell Theory

THE hundredth anniversary of the discovery of the cell by Th. Schwann is being commemorated this year in many countries. There seems, however, to be a mistake about the date of this great discovery. Schwann's "Mikroskopische Untersuchungen" bears the date 1839 ; but the first two—and I think the most important—parts of the book had already appeared in 1838. The edition must have been very small, for I have seen only one copy of them during the last twenty years. Schwann placed the 1838 edition before the Paris Academy of Sciences. At all events we are, I think, late in our commemoration.

A few years ago, by the way, I made a similar blunder. I published in my "Facsimile Edition" a reprint of the first edition of Galvani's famous work which had appeared in 1792. But I discovered too late that this work had already been published as a paper a year earlier in the 'Commentarii' of the Academy of Bologna. My reprint was in reality only that of the first edition of the *separate* work.

W. JUNK.

The Hague,
March 4.

Points from Foregoing Letters

J. G. Daunt and K. Mendelssohn find that a 'transfer' of liquid helium II takes place along a solid surface when a temperature gradient is kept up. They also observe that a flow of liquid helium II through a powder plug is accompanied by a caloric effect. These results seem to support the idea that the transport phenomena in liquid helium II are mainly due to surface flow.

A new method for obtaining photographic records of refractive index gradients in a column of solution is described by Kjell J. I. Andersson. The refraction methods now used in ultracentrifugal practice are briefly discussed and the new procedure compared with an analogous method described by Philpot.

Several factors are presented by R. B. Dean, O. Gatty and E. Stenhagen which may invalidate the assumption that the thickness of multilayers of protein is a measure of the thickness of a surface layer of the protein on water. Conditions for avoiding these errors are set forth and the orientation of the layers of protein on the slide is also considered.

A. H. Nissan and L. V. W. Clark state that a reasonable basis of comparison for studying the viscosity of liquids has been found so that an homologous series, for example, the *n*-paraffins, yields a solitary curve for all its members, with the exception of the first few, independent of molecular weight. It is generally accepted that in $\eta = Ae^{B/T}$, B is invariant with temperature for unassociated liquids. Evidence is given that B is a function of temperature even in the case of *n*-paraffins. From an examination of a large number of liquids it is possible to classify them into three groups with regard to viscosity : normal, associated and metallic.

Assuming that, at the melting point the energy per unit area of a liquid surface is given by the total energy of the molecules in a surface layer of unit area, each molecule vibrating with a frequency equal to the Lindemann frequency, L. Sibaiya and M. Rama Rao arrive at a simple formula connecting the surface tension of a liquid with the molecular mass and the Lindemann frequency. The values obtained in the case of forty-five substances investigated were found to be of the right order of magnitude.

The natural radio wave-length of an antenna is found by R. Nakhla to increase with the electrical conductivity of the surroundings up to a definite limit and then to become constant.

Ch. Weizmann, E. Bergmann and Y. Hirshberg point out that the enzymatic hydrolytic de-amination of amino-acids, recently discovered by Virtanen and Erkama, parallels the analogous photochemical process, which is more general. The behaviour of histidin is quoted as an example.

M. Stacey and Miss E. Schlüchterer find that certain drugs of the sulphonamide group have no chemical action *in vitro* on specific capsular polysaccharides from Types I and II pneumococcus. The tentative theory is advanced that sulphonamide drugs are active *in vitro* since they can render unavailable to the invading bacteria highly essential 'accessory growth factors' which are responsible for capsule formation ; deprived of their protective mechanism, the organisms fall prey to the phagocytic action of the body and the infection is aborted.

John R. Loofbourow and Sister Cecelia Marie Dwyer have found evidence that living cells produce growth factors ('intercellular wound hormones') as a physiological response to injury in the fact that the production of such factors precedes the killing of yeast by lethal ultra-violet and occurs in suspensions of living cells aerated with carbon dioxide.

A preparation from various tissues of flowering plants showing the complete cytochrome spectrum has been obtained by R. Hill and Miss K. Bhagvat. The cytochrome is associated with cytochrome oxidase and succinic dehydrogenase showing the presence of a respiratory mechanism in the plant identical with that characteristic of animals.

Research Items

Socio-political Grouping in the Great Basin, U.S.A.

IN 1935 the University of California, and in 1936 the Bureau of American Ethnology, instituted an ethnographic reconnaissance of the Western Shoshoni and their Paiute and Ute neighbours of the Great Basin area, under Julian H. Steward. In a study of their socio-political groups (*Bull.* 20, Bur. Amer. Ethnol., 1939), it is shown what are the sociological patterns among these simple hunters and collectors, and the factors which produce them are analysed. Most of the Basin Plateau peoples live at bare subsistence level, and their culture is meagre in content and simple in structure. Problems of daily existence dominate their activities and limit and condition their institutions. Population density depended directly upon the quantity of plant and animal food which the hunting or gathering devices known in the area allowed to be procured. This, therefore, determined in each region the size, nature and permanency of the population aggregate, which in turn determined the social structure and political controls. Generally exigencies of existence allowed little latitude for variation; but where ecology permitted such latitude, warfare, festivals, ceremonies, etc., became determinants of sociological patterns. Hence among the Western Shoshoni and Paiute it was physically impossible for families to remain long in one place or in permanent association. The outstanding sociological unit, therefore, was the biological family and the small winter village.

Carbohydrate Metabolism and Muscular Work

F. C. Courtice, C. G. Douglas and J. G. Priestley (*Proc. Roy. Soc.*, B, **127**, 41; 1939) have studied in detail the respiratory exchange and quotient and the sugar, lactic acid and carbon dioxide combining power of the blood in two subjects during the period after prolonged moderate muscular work (a ten-mile walk at a speed of 4½ miles per hour). During rest after work there is a reduction in the glucose tolerance, which is very like that following a low-carbohydrate, high-fat diet, and is also associated with a low respiratory quotient and ketonuria. It appears, therefore, that the low R.Q. after exercise is to be attributed to a diminution in the ratio of carbohydrate to fat oxidized. There was no evidence that the reduced tolerance to glucose was accompanied by a change in the sensitivity of the tissues to insulin, since the response of the blood sugar to intravenous insulin was the same whether after exercise or after a low-carbohydrate, high-fat diet. The administration of insulin is followed by a prolonged but slight increase of the respiratory quotient, suggesting an increased oxidation of carbohydrate, and it is tempting to assign the similar rise in quotient which occurs during exercise to the same cause. The injection of insulin is, however, accompanied by a large fall of blood sugar, and such falls do not occur during exercise. It is probable that other endocrine secretions, for example, adrenaline, play a considerable part in the control of carbohydrate metabolism during exercise. Administration of adrenaline causes an increase in the oxygen consumption, hyperglycæmia and certain characteristic changes in the lactic acid of the blood. If insulin and adrenaline are injected together, they neutralize one another in so far as their effects on the blood sugar are concerned, but the changes in the blood lactic acid are the same as if adrenaline alone were injected.

Habits, Distribution and Anatomy of *Ophelia cluthensis*

IN 1935, I. P. McGuire described a new polychæte worm from the sands near Millport under the name of *Ophelia cluthensis* which had escaped recognition until that time, sometimes possibly because it had been taken for the young of another species. R. S. Brown (*Proc. Roy. Soc. Edinburgh*; 1938) has given a full account of the habits, distribution and anatomy of this form, thus establishing completely its identity and specific distinctness. The adult reaches a length of 15 mm. in the male and 18 mm. in the female or rarely slightly larger than this, so it is not a large worm. It has twenty-five segments, all save the last being setigerous, and 8–10 pairs of gills. The body wall is semi-translucent so that the animal is a pinkish colour due to the colour of the hæmoglobin-containing blood showing through. It is found just below high-water neap tides, and in spite of its recent discovery may be present up to 273 per square metre.

Effect of Apple Diet on Intestinal Flora

G. M. Dack, R. Johnson and L. R. Dragstedt (*J. Inf. Dis.*, **64**, 52; 1939) have made a comparative study of the bacterial flora of the duodenum, ileum and cæcum of three *Macaca mulata* when these monkeys were on a control and a raw apple diet. Surgical fistulæ were made in the three levels of bowel to simplify the removal of specimens under physiological conditions. The bacteriological examination included the determination of the relative numbers of *Bact. coli*, the predominant organism, and the numbers of *L. acidophilus* in the cæcum. Dysentery bacilli were looked for as the monkey is a susceptible host to bacillary dysentery. A search was also made for *Bact. necrophilum*, which has been associated with ulcerative processes in the bowel of man and animals, but with negative results in both cases. No essential differences were found in the flora of monkeys on a control diet as compared with the apple diet. The authors conclude that any therapeutic effect that raw apple diet may have is not by virtue of any change which occurs in the bacterial flora of the bowel. Hydrogen ion determinations were made and there was no radical shift in the *p*H of the cæcum which would account for inhibitory effects or bacterial growth.

Phenology of 1938

THE Phenological Report, 1938, by Major H. C. Gunton (*Quar. J. Meteor. Soc.*, **65**, No. 279; 1939) is the forty-eighth annual report of this kind. For meteorological reasons the period with which it is concerned, namely, December 1937–November 1938, is one of exceptional suitability for the study of the

reactions of wild life to abnormal conditions. The change from winter to summer in the British Isles, instead of taking place in its usual rhythmical manner, spring being made up of short bursts of warmth, sometimes equal to that of summer, followed by abrupt wintry retrogressions due to sudden incursions of cold air from the Arctic, seemed on this occasion likely to be a sudden one, winter holding sway in February and summer from the beginning of March onwards. In actual fact, however, the exceptional warmth of March did not persist beyond that month, and there were long cold and dry periods in April and May, with frequent night frosts. These conditions caused much damage to blossom and foliage, and the report instances cases where song thrushes and blackbirds deserted the young birds in their nests in the drought, when insects must have been unusually scarce. The weather continued very abnormal even after May, for there were notably severe midsummer gales, and very stormy weather again in October, which resulted in an early fall of the leaves, which had already suffered damage. In November came the second spell of unseasonable summer warmth, which was as remarkable as that of March except in its duration. It is not surprising that butterflies and moths were on the whole scarce throughout the year, but there were some exceptions, among them the silver ground carpet moth and the chalk hill blue butterfly. Red admirals, moreover, were observed in large numbers in September and October, and even as late as November. The early fall of the leaves made the autumn a poor one for colour, but the November warmth caused numerous abnormal second flowerings of shrubs and trees.

The Weddell and Ross Seas

THE Weddell Sea and the Ross Sea, the two great bights on the opposite sides of the Antarctic continent, have different relations with the Southern Ocean. These contrasts are indicated by G. E. R. Deacon in a paper on the "Antarctic Voyages of R.R.S. *Discovery II* and R.R.S. *William Scoresby* 1935–37" in the *Geographical Journal* of March. In the south-west of the Weddell Sea freezing is intense in winter; this raises the salinity of the surface layers by the salts left when the ice is formed. Thus the surface waters sink rapidly and, as a bottom current, spread over the whole Southern Ocean and northwards into the Atlantic, Indian and Pacific Oceans. Bottom temperatures and salinities at great depths show a continuous increase towards the east and the oxygen content a continuous decrease. The increase in temperature is due to mixing with the deep Southern Ocean water subsequent to sinking from the cold surface, and the decreased oxygen content is due also to distance from surface origin. It is thus clear that the Weddell Sea is the chief supplier of the cold bottom water. The Ross Sea has comparable surface conditions but a submarine ridge between Cape Adare and King Edward Land cuts off the bottom waters from the Southern Ocean. This basin, south of the ridge, is filled with very cold saline water that cannot escape. Thus the Ross Sea has little influence on oceanic circulation in general.

Analysis of Ethylene Oxide - Carbon Dioxide Mixtures

A MIXTURE of carbon dioxide (90 per cent) and ethylene oxide is now largely used as a fumigant. The analysis of this mixture has caused some difficulties and J. R. Branham and M. Shepherd (*J. Res. Nat. Bur. Stand.*, **22**; February 1939) have now described a simple and accurate method with a reproducibility of 0·05 per cent. Ethylene oxide is rapidly and quantitatively absorbed by a small volume of sulphuric acid, which takes up more than 5,000 times its volume of the oxide but no significant amount of carbon dioxide, which is then absorbed in concentrated potash solution. A type of apparatus in which the gases are measured dry is described.

Reduction of Silver Ions by Hydroquinone

ALTHOUGH the reduction of silver ions by hydroquinone is of considerable interest in connexion with photographic development and fogging action, no detailed investigation of its mechanism has been made until recently. T. H. James (*J. Amer. Chem. Soc.*, **61**, 648; 1939) has now studied the reaction in gelatin and gum arabic solutions. The reaction in slightly acid solution is strongly catalysed by colloidal silver, gold, palladium and silver sulphide. The rate of reaction catalysed by silver varies as the first power of the hydroquinone concentration and as the two thirds power of the silver ion concentration. The dependence of the rate upon the hydroxyl ion concentration shows that both unionized hydroquinone and the univalent ion participate in the reaction in the *p*H range 5·15–6·27. The rate of the catalysed reaction varies proportionately with the surface of the catalyst and inversely with the concentration of gum arabic. The mechanism suggested by the results involves a primary adsorption of silver ions on the surface of the catalyst, as is indicated by the fractional power of the concentration. No adsorption of hydroquinone is disclosed by the experiments. The difference between the mechanism and that found for the reduction of silver ion by ferrous ion, which indicates that the homogeneous reaction between the ions is very rapid in comparison with the rate of deposition of silver on condensation nuclei, is pointed out.

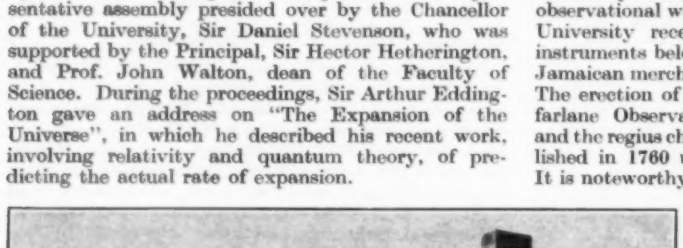
Solid Adsorption

THE great influence which the addition of a very small proportion of a second metal may have on the resistance of a metal to corrosion has been known for some time; for example, small quantities of aluminium added to copper or brass retard oxidation. In two recent papers (*Bull. Polish Acad.*, March–May and October–December, 1938), the first by Dr. S. Dobinski, the second by Drs. Dobinski and Jagielski of Cracow, it is shown that these effects are due to adsorption of one of the constituents of the solid solution at the surface, in accordance with the Gibbs rule of the 'Equilibrium' paper of 1878, that if diffusion of the constituents can take place the one with the smallest surface tension will concentrate in the surface. Unfortunately the surface tensions of solids have not yet been measured, but Desch and others conjecture that they are proportional to those of the liquids. By surface electron diffraction photographs the authors show that for alloys of lead and antimony, zinc and tin, copper and calcium, silver and cadmium, copper, aluminium and nickel, and copper, aluminium, nickel and magnesium, the constituent which concentrates in the surface when polished or when the alloy is heated to about 200 °C. is in each case that the surface tension of which in the liquid state is the least.

The University Observatory, Glasgow

By Prof. W. M. Smart

THE new observatory buildings of the University of Glasgow were formally opened on April 17 by Sir Arthur Eddington in the presence of a representative assembly presided over by the Chancellor of the University, Sir Daniel Stevenson, who was supported by the Principal, Sir Hector Hetherington, and Prof. John Walton, dean of the Faculty of Science. During the proceedings, Sir Arthur Eddington gave an address on "The Expansion of the Universe", in which he described his recent work, involving relativity and quantum theory, of predicting the actual rate of expansion.



[*Glasgow Herald.*

UNIVERSITY OBSERVATORY, GLASGOW. TOPS OF THE TRANSIT HOUSE AND THE 7-INCH DOME ARE SEEN ON THE RIGHT.

Owing to the exacting demands of modern observational astronomy as regards instrumental equipment and favourable atmospherical conditions, the new observatory (which is within a stone's throw of the main University departments) has been designed mainly for instructional purposes. The principal room of the main building is a library which can also be used for lantern lectures; a fine collection of fifty astronomical transparencies is mounted in this room. The other accommodation consists of a large instrument room and rooms for the director and his assistant. A 7-inch refractor carrying a small spectroscopic equipment is mounted on the high ground behind, and close by is a transit house. The observatory is also well equipped with subsidiary instruments. For two centuries and perhaps more, particularly during the last thirty or forty years, comprising the directorship of Prof. Becker, astronomy has proved, academically, to be of interest to a fair number of students, and it is hoped that the new facilities will further encourage astronomical study and research in the University.

The present observatory is the third astronomical institution established by the University. The Old College of Glasgow was in possession of a telescope so far back as 1693, and although astronomy was one of the subjects taught in these early days by the occupant of the chair of physics (or, from 1727, of natural philosophy), no proper accommodation for observational work was provided until 1756, when the University received the valuable bequest of the instruments belonging to Alex Macfarlane, a wealthy Jamaican merchant and a graduate of the University. The erection of an observatory—known as the Macfarlane Observatory—was immediately undertaken and the regius chair of practical astronomy was established in 1760 under a warrant of King George II. It is noteworthy that it was the establishment of the Macfarlane Observatory that led directly to James Watt's appointment as instrument maker to the University, and it was in this capacity that he effected the improvements in the steam engine that made his name world famous.

At the beginning of the nineteenth century the rapid extension of the city and the increasing industrialization of the neighbourhood made astronomical observations almost impossible, and matters were not improved when some fifteen or twenty degrees of the meridian were securely blocked by the high steeple of a new parish church. It would appear that by 1820 the Macfarlane Observatory was reduced to little more than a centre of instruction, and it was there that Kelvin was taught the use of astronomical instruments.

In 1836 Prof. John P. Nichol was appointed to the chair—one of the applicants, it is of interest to note, was Thomas Carlyle. Nichol's success as a lecturer led to the formation of the Astronomical Institution of Glasgow, and a new observatory, with Nichol as director, was established as a private concern in 1841 at Dowanhill. The enthusiasm of the Glasgow citizens, however, waned with almost as great a rapidity as it had been stimulated, and in 1843 the University acquired the Observatory, together with the liabilities of the dead society. Nichol's successor was Prof. Robert Grant, whose two great publications—"The Glasgow Catalogue of 6415 stars" and the "Second Glasgow Catalogue of 2156 stars"—form a remarkable output for an observatory with such limited resources. The last effective directorship at Dowanhill was that of Prof. Becker, from 1893 until 1935. On his retirement, the University was confronted with the same problem which the academic authorities had to face, a century or more before, in connexion with the Macfarlane Observatory. The new observatory at Gilmorehill represents the solution. If auguries have any significance, the brilliant address of Sir Arthur Eddington and the benediction of an unclouded sun on the opening day should spell the beginning of a career of usefulness to the new institution in a University and City where astronomy and science as a whole have such long traditions.

The Early Sealers in West Antarctica*

PROF. W. M. HOBBS has written a long and elaborately illustrated monograph on the history of the Graham Land area of Antarctica from Smith's discovery of the South Shetlands in 1819 to Ellsworth's flight in 1936. The earlier years of this history have been much discussed by Mill, Balch, Nordenskjöld, Bruce and others, but assiduous search from time to time reveals new material, chiefly in the form of forgotten log books. Prof. Hobbs's reproductions of early maps alone give his monograph great interest. Some of his conclusions, however, do not appear to be justified from the available facts. Thus he goes to great pains to prove that the Antarctic continent was first sighted in November 1820, when the American sealer, N. B. Palmer, saw land to the south and south-east of Deception Island of the South Shetlands. This land soon after appeared on maps as Palmer Land and is now regarded as a part of the Trinity Peninsula of Graham Land. Prof. Hobbs, however, is entirely unconvincing in his refutation of the accounts and charts which are available establishing Bransfield's sighting of Trinity Land in January and February 1820. W. S. Bruce, and later R. T. Gould, have shown convincingly that Trinity Land was the original discovery of Antarctic land and preceded Palmer's discovery by at least ten months. The attempt to establish an American discovery of Antarctica fails.

The chief interest, however, in Prof. Hobbs's monograph lies in his strictures on Weddell. These strictures have a weak foundation, but since they impugn the veracity and reputation of a notable explorer, cannot be overlooked. Between 1819 and 1824, Weddell made three southern voyages in the course of which he surveyed in part the South Shetlands and the South Orkneys and gained a high southern latitude in lat. 74° 15′ S., long. 34° 16′ 45″ W. in the Sea of George the Fourth, which is now called the Weddell Sea. He published his account of these voyages, his discoveries and his route chart in his well-known volume "A Voyage Towards the South Pole", etc. (London, 1825). He sailed southwards into the Weddell Sea about long. 30° W. and came north again between long. 30° and 40° W. from his southern record where he saw a sea free from field ice with only four icebergs in sight. He had, however, seen "many ice islands" in places on the way south. Ross, twenty years later, failed on account of ice to follow Weddell's route, and the *Scotia* in 1903 had to keep farther eastward to gain a high latitude, but in 1904 crossed the middle of an almost ice-free Weddell Sea and reached lat. 72° S. before difficulty began. The *Deutschland* and the *Endurance* in later years were caught and drifted in Weddell's longitudes. But from these scanty records we are not entitled to assert, as Hobbs does, that the Weddell Sea is unnavigable. The pack of the Weddell Sea is partly due to local formation in that sea and partly due to the sweep of pack from the east which is caught in this great bight. The pack is carried towards the south-west coast which may be always blocked, and then flows north before wind and current until, in the latitudes of 65° to 60° S., it is swept eastward again by the set of winds and the eastward drift of the waters. With the amount and distribution of the pack in the Weddell Sea dependent on many factors, local and general, it would be surprising if the distribution of ice remained constant, as indeed a limited knowledge of that sea shows not to be the case.

Wordie has commented on the low average wind velocity in the Weddell Sea as promoting ice congestion in the western side. A year of unusually strong southerly winds in this area might easily clear away the ice for several weeks or even for a whole season. Years or periods of open water are likely to occur, and Weddell was fortunate enough to sail in such a season. Hobbs's deductions on the state of ice, based on the scanty data available, are not a foundation for the destruction of Weddell's reputation and the slandering of his name. Similarly, Hobbs's charge that Weddell did not make surveys in the South Shetlands but merely copied Powell's earlier map (published in 1922) would seem to ignore Weddell's practice of surveying from boats and not direct from his ship, for which reason Weddell did not mark his route among island groups. It is a pity that such charges should disfigure a work that comprises much research, even if some of it lacks scholarship.

R. N. R. B.

* The Discoveries of Antarctica within the American Sector, as revealed by Maps and Documents. By W. M. Hobbs. *Trans. Amer. Phil. Soc.*, Philadelphia. New Series, **31**, Pt. 1, pp. 1–71; 1939.

Absorption Spectra of Single Crystals of Hæmoglobin in Polarized Light

By M. F. Perutz, Cavendish Laboratory and Molteno Institute, Cambridge

SINGLE crystals of hæmoglobin generally show strong pleochroism[1]. They are dark red and almost opaque in two extinction directions and become light red and transparent in the third. An investigation of the absorption spectra corresponding to the principal vibration directions was undertaken with the view of obtaining information on the molecular structure of hæmoglobin.

Horse methæmoglobin crystallizes in the monoclinic system, as described in a previous paper[2], and is usually obtained in the prismatic form terminated by domatic faces (Fig. 1). The orientation of the optic axes may be seen from the figure; the sign of the double refraction is probably negative. The crystals show strong absorption in vibration directions parallel to β and γ, and weak absorption parallel to α.

The absorption spectra of the crystals were studied while they were mounted on microscope slides and immersed in their mother liquor (3 parts sat. $(NH_4)_2SO_4$ + 1 part molar $(NH_4)_2HPO_4$; pH = 6·3) to which gum tragacanth had been added in order to keep the crystals stationary. Preparations were made with crystals lying on their *a*, *b* and *c* faces respectively, the last two having been cut with a razor blade. The absorption spectra were observed through a microspectroscope replacing the eyepiece of a polarizing microscope.

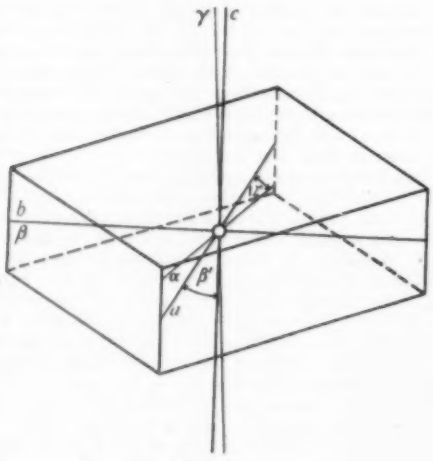


Fig. 1.

CRYSTAL OF HORSE METHÆMOGLOBIN.

The axial ratios are $a : b : c = 1·72 : 1 : 0·86$; $\beta' = 68°$. α makes an angle of 12° with a; β is parallel to b; and γ makes an angle of 10° with c. The domatic faces are 210 faces.

In unpolarized light, the spectra of the crystals conformed with the spectrum of acid methæmoglobin in solution, showing a strong absorption band at 637 mμ, faint bands at 582 mμ and 548 mμ and a general absorption increasing from the green towards the violet end of the spectrum. (The band at 504 mμ was not visible owing to the low resolving power of the spectroscope.)

The results of the spectroscopic examination in polarized light are recorded in the accompanying table.

Vibration direction parallel to	Absorption band at 637 mμ	Absorption bands at 582 and 548 mμ	General absorption in the green and blue
α	weak and smeared	faintly visible	weak
β or γ	strong, broad and sharply defined at the boundaries	not visible, probably overshadowed by general absorption	very strong

As the α, β and γ directions are parallel or nearly parallel to the *a*, *b* and *c* axes, the crystals show strong pleochroism when the light is travelling perpendicular to the *b* or *c* planes, whereas pleochroism is completely absent when the light is travelling at right angles to the *a* plane.

Crystals of methæmoglobin can be treated with acid without being immediately dissolved. If a drop of *n*/10 HCl was added to the mother liquor, the acid could be seen to penetrate the crystal by the change in colour which travelled from the edges towards the centre. Simultaneously, the spectrum changed gradually from that of methæmoglobin to that of ferrihæmatin chloride, the edge of the absorption band in the red (637 mμ) shifting from 640 mμ to about 675 mμ, until finally a very broad band stretched from about 640 mμ to 680 mμ. At the same time, an increase in the general absorption in the green and blue could be noticed. Strong pleochroism was visible for several minutes after the acid had penetrated the crystal, which was lying on its *c* face. When the vibration direction was parallel to β, the bands of the spectrum of acid hæmatin, especially the band in the red, were strong and sharp. If the nicol was turned, the band contracted from the red end until it was narrow and smeared, when the vibration direction was parallel to α. After five minutes the pleochroism disappeared and the crystal dissolved.

Crystals of *sheep methæmoglobin* were obtained in large thin pseudohexagonal plates which X-ray analysis had shown to be triclinic. Their spectrum

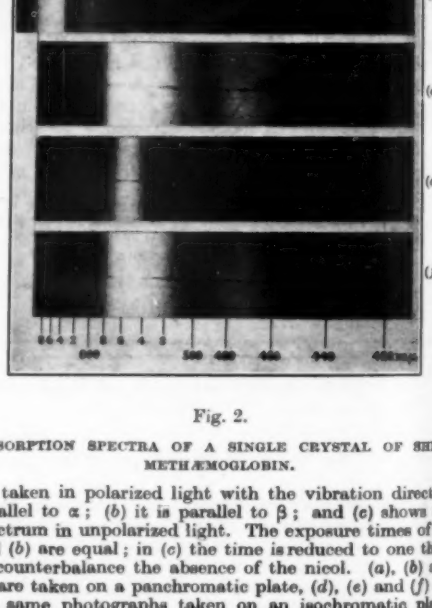


Fig. 2.

ABSORPTION SPECTRA OF A SINGLE CRYSTAL OF SHEEP METHÆMOGLOBIN.

(*a*) taken in polarized light with the vibration direction parallel to α; (*b*) it is parallel to β; and (*c*) shows the spectrum in unpolarized light. The exposure times of (*a*) and (*b*) are equal; in (*c*) the time is reduced to one third to counterbalance the absence of the nicol. (*a*), (*b*) and (*c*) are taken on a panchromatic plate, (*d*), (*e*) and (*f*) are the same photographs taken on an isochromatic plate. The reproductions are positives. The arrow in (*c*) indicates the absorption band in the red.

was similar to that of horse methæmoglobin, except that the absorption in the green was more pronounced. The small thickness of the crystals rendered examination in any other than the *c* plane impracticable, but made it possible, on the other hand, to get spectra which were bright enough to photograph (Fig. 2). The photographs taken on the panchromatic plate show the change in width and strength of the band in the red, while those on the isochromatic plate illustrate the variation of the general absorption in the green and blue.

In needles of *horse oxyhæmoglobin*, both the characteristic absorption bands in the green and in the yellow were strong and sharp when the vibration direction was perpendicular to the needle axis, and faded out when the vibration direction was parallel to it.

In horse methæmoglobin the absence of pleochroism in the *a* plane and the sharpness of the band in the red in combination with the high general absorption in the green and blue in vibration directions parallel to β and γ, indicate that the four hæme groups contained in one molecule are approximately parallel to each other and lie in the *a* plane. This orientation also agrees with the positions of the high refractive indices. It was shown by the effect of acid on the crystals that the absorption must be due to dipoles induced in the hæme groups themselves, since the relation of the absorption bands to the vibration directions in the crystal remained unchanged even after the hæme groups had become detached from the globin component and the position of the absorption band had shifted to that corresponding to free ferrihæmatin chloride.

In drawing these conclusions it has been assumed that the coefficient of absorption is high when the electrical vibration of the polarized light is parallel to the hæme groups and low in any other direction. This assumption appears justified, since the strong colouring power of the hæmatin complex is understood to be due to its large planar system of conjugated double bonds, and dipoles induced in this system must reach their maximum value when the electrical vibration of the light is parallel to the plane containing the double bonds. This relation between pleochroism and molecular orientation has been established by Bernal and others, who applied it to the structure analysis of crystals possessing layers of flat molecules or chains[3].

X-ray data showed that the four hæme groups in methæmoglobin must be arranged in pairs related by twofold axis[3]. Their parallelism now indicates that they may lie at the corners of a square as suggested by Pauling[4]. In horse oxyhæmoglobin their arrangement appears to be the same as in methæmoglobin, since its crystals belong to the same system, have similar axial ratios and exhibit the same type of pleochroism[1]. According to Haurowitz[5], reduced horse hæmoglobin crystallizes in the form of hexagonal plates, which on contact with oxygen change spontaneously into the monoclinic needles of oxyhæmoglobin. This change of symmetry indicates that a rearrangement of the hæme groups may take place on reduction.

I have to thank Dr. G. S. Adair for his collaboration in preparing the crystals, Prof. J. D. Bernal for suggesting this research, and Prof. D. Keilin and Dr. E. F. Hartree for much practical help and advice.

Summary. The absorption spectra of single crystals of hæmoglobin in polarized light have been examined. In met- and oxyhæmoglobin of horse and in methæmoglobin of sheep, the width and strength of the absorption bands was dependent on the vibration direction of the polarized light. The results indicate an approximate parallelism of the four hæme groups in the met- and oxyhæmoglobin molecule.

[1] Reichert and Brown, "The Crystallography of the Hæmoglobins" (Carnegie Inst., Washington, 1909).

[2] Bernal, Fankuchen and Perutz, NATURE, **141**, 523 (1938).

[3] Bernal and Crowfoot, *Trans. Farad. Soc.*, **29**, 1032 (1933). Taylor, *Z. Kristall.*, A, **93**, 151 (1936). Wells, *Proc. Roy. Soc.*, A, **167** 172 (1938).

[4] *Proc. Nat. Acad. Sci.*, **21**, 186 (1935).

[5] *Z. physiol. Chem.*, **254**, 266 (1938).

Chemistry and its Applications in Modern Life

Meeting of the American Chemical Society

A MEETING of the American Chemical Society was held early in April at Baltimore, when many papers of topical interest were presented. Grouping the papers by subjects, it is possible to indicate some of the more striking advances which were recorded.

One group of papers dealt with vitamins and hormones. The close relation between vitamin A and vitamin A_2 (occurring in visual purple and in the livers of freshwater fish) has been established by distillation under very low pressure. Papers on the content of vitamin C in various vegetables and its changes on boiling and storage showed, among other things, that loss on boiling is reduced by putting a cover on the vessel so as to exclude air. A covered aluminium vessel was better than covered glass or enamel vessels unless sodium carbonate was added to the green vegetable, in which case the loss was greater with the aluminium vessel. Contrary to the general belief that citrus fruits and tomatoes are the richest sources of the antiscorbutic vitamin C, it has been found that freshly picked parsley, broccoli, kale and cauliflower contain two to three times as much vitamin C as citrus fruits. Vitamin A concentrates were found not to lower the fat content of milk produced by cows fed on them, whilst fish oils tended to lower the fat content.

Whey has been shown to be a valuable source of vitamins and vitamin products, including all the known water-soluble vitamins, the fat-soluble provitamin D, vitamin K (pro-thrombin), vitamin E, œstrin and vitamin B_2 or G. The importance of whey as an adjunct to feeding animals was shown experimentally. The use of whey products in human foods, especially in bakery goods and confectionery, has also been the object of research.

Zinc insulin crystals have been widely used in the treatment of diabetes in the United States and Canada. The chemistry of the visual systems and of the adrenal cortical hormones has been actively

worked upon. Adrenal gland extract has been shown to contain at least twenty-four different substances allied to cholesterol, bile acids and the sex hormones, one of them being progesterone, the hormone produced by the corpus luteum of the ovary. The biological functions of the pituitary gland have been more closely investigated and the results correct many views formerly held in this field. For example, it is now known that certain physiological effects claimed to be due to different separate anterior pituitary principles can be attributed to one principle, exerting these effects in ways depending on its mode of administration. Doubt has been cast on the assumption that the thyroid stimulating effect of the pituitary is produced by a separate principle acting on the thyroid gland only.

Another group of papers dealt with cellulose and cellulose products. The purification and utilization of wood cellulose have been investigated, and the suitability of various kinds of woods studied. The main object in view was the production of a cellulose suitable for the production of viscose, since this accounts for 80 per cent of the wood-pulp cellulose used for chemical purposes. An interesting paper dealt with the use of the whole cotton plant with ripe bolls for the production of cellulose; the oil is first extracted from the seeds of the whole ground plant and the cellulose isolated from the residue.

Petroleum and its products received attention from several points of view. The dehydrogenation of petroleum by cracking has led to an increased supply of reactive olefines used in the synthesis of iso-octane, ketones, organic derivatives and plastics. The production of aviation fuels by high-pressure hydrogenation is increasing, one of the principal blending agents being iso-octane. New catalysts have been developed. The superior fuels now available have enabled engine manufacturers to build engines capable of greater power output per unit weight. The stabilization of petrols by small quantities of organic compounds known as deactivators, which prevent oxidation, is an important advance.

Casein products and the utilization of lactic acid provided topics of interest from the point of view of plastics, including polymethylacrylate from lactic acid. A wool-like fibre is made from casein by dissolving in alkali solution and forcing under pressure into a solution containing acid, formaldehyde and either salts or sugars. The fibre is then treated with oils and other substances to increase its flexibility and strength and to bleach it, and is cut into staple lengths, carded and spun into yarn. It may be dyed and laundered in the same way as wool. It shrinks less than wool but has poor tensile strength, especially when wet.

Resins, shellac varnishes, house paints, organic sulphur compounds, and other topics of technical interest also featured in the papers. Of more academic interest were papers on exchange reactions of heavy isotopes of oxygen and nitrogen. The use of aspartic acid as an anticoagulant for blood is of medical interest, as it prevents clotting in the circulation. Aspartic acid is a natural component of plant and animal tissues; it is used as the sodium salt injected intramuscularly, but further studies are to be made of the possible injurious effects on the kidney such as are noted with other anticoagulants. It is stated that, of the long list of amino-acids formed from proteins in digestion, only two have any appreciable effect in preventing clotting, namely, cysteine and aspartic acid, and aspartic acid is much more potent.

Science News a Century Ago

The Zoological Society

THE anniversary meeting of the Zoological Society was held on April 29, 1839, Lord Braybrooke being in the chair, when the reports for the year were submitted. That by the auditors stated that the receipts had been £14,094 2*s*. 9*d*. and the expenditure £12,588 12*s*. 1*d*. Among the assets of the Society was the farm at Kingston valued at £11,000. In the report of the Council it was stated that steps were being taken to reduce greatly the permanent expenditure. In 1837 salaries were £3,548, but for the coming year that would be reduced to £2,916. An increase had taken place in the cost of provisions due to an increase in the number of animals, "and amongst other circumstances to the growth of the larger elephant". There were 3,010 members of the Society, 38 candidates for election and 126 corresponding members. The Museum contained 760 mammalia, 5,230 birds, 1,000 reptiles, 1,170 fishes and 83 mounted skeletons.

Jupiter's Satellites

UNDER the above title, the *Athenæum* of May 4, 1839, said, "An irregularity in the first satellite of Jupiter has for some time attracted the attention of M. Boguslawski, the director of the observatory at Breslau. He observed it on the 14th of April 1838, and on the 1st of May he made further observations, when he found that its lustre, which, generally speaking, is greater than that of the second, appears to be much weaker when it quits the disc of the planet after its passage across, especially when its shadow is seen upon Jupiter. By means of the heliometer he kept the second satellite always by the side of the first, and at the same distance from the disc, in order to ascertain if the light of the planet were the cause of the diminution. For several hours after leaving the disc at 12 h. 54′ 26·2″ sidereal time, the first satellite was evidently paler than the second; it then slowly began to resume its light, but which at 15 h. 18′ had not yet attained that of the second. The next day it had quite resumed its lustre, and again surpassed that of the second".

Palon Heinrich Ludwig von Boguslawski was born at Magdeburg in 1789 and died in 1851. He was well known for his observations of comets and published an astronomical year-book, entitled "Uranos".

Further Discoveries by M. Lartet

IN its column of Miscellanea, the *Athenæum* of May 4, 1839, said: "The indefatigable M. Lartet, of whose labours we have so often spoken, announced the discovery of two fossil Carnivora, one of which appears to constitute a sub-genus, intermediate between the badger and the otter, and the second approaching to the dog, differing but little from that gigantic fossil which he has described under the name of Amphicyon. He is of the opinion that the latter is the same animal as that of which some remains were found at Epelsheim, and which constitute the Agnotherium of M. Kaup. There are a considerable number of fossil mammiferæ found on the border of the Rhine, which appear to be identical with those which are daily brought to light at the foot of the Pyrennees. These affinities are the more interesting, because the intermediate countries, Auvergne, for instance, possessed very different races of animals."

Societies and Academies

Paris*

Academy of Sciences (*C.R.*, **208**, 853–952, March 20, 1939).

A. ROSE : Thermal dissociation of zinc carbonate.

A. DOGNON and C. PIFFAULT : Action of various radiations on superficial films of proteins.

MME. M.-E. RUMPF-NORDMANN : Contribution to the study of some permolybdates.

E. GRILLOT : Lead halogen-ethanoates.

H. SCAETTA : A phenomenon of *expurgation allitique* of tropical soil in West Africa.

N. MENCHIKOFF : Carboniferous of Issaouane (Central Sahara).

C. FRANCIS-BŒUF : Remarks on some measurements of salinity of the waters of the Orne, between Caen and the mouth (Franceville).

L. CAGNIARD : Propagation of a signal in a rarefied ionised atmosphere. The speed is that of the group.

G. BOUVRAIN : Presence of woody bundles in the upper part of the root of *Helianthus annuus* (var. *uniflorus*).

J. MAGROU : New attempts at the cultivation of mycorrhizal fungi.

MLLE. L. LEVINA : Contribution to the study of the movement of water and of dissolved substances across plant tissues.

L. PLANTEFOL and R. GAUTHERET : Glucose and the respiration of plant tissue cultures.

A. DE PUYMALY : Modifications undergone by an alga taking part in the constitution of a lichen (*Placynthium nigrum* S. Gray).

MLLE. L. PIETTRE : Differentiation of reproductive organs in abnormal buds of *Solanum tuberosum* L. var *Esterlingen*.

MME. S. VILLENEUVE-BRACHON : Superficial structures of heterotrich ciliates and the genetic continuity of their *cinétome*.

P. LESNE : Polymorphism of certain Bostrychid Coleoptera.

M. ROSE : Physiology of the parabasal of *Trypanophis Grobbeni* Poche.

MME. L. RANDOIN and C.-P. LEBLOND : New biochemical method of estimating vitamin C.

MLLE. P. BERTHIER : Coefficient of specific magnetization of oxyhæmoglobin.

A. LEMOS : Examination of some substances as precursors of ascorbic acid.

J.-H. VIVIEN : Role of the hypophysis in the determinism of the female genital cycle of a teleostean, *Gobius paganellus* L.

J.-C. VLÈS : Physico-chemical properties of desoxycholic acid.

(*Continued from p. 695.)

Cracow

Polish Academy of Sciences and Letters (Feb 6, 1939).

S. BANACH : The 'supreme law' of Hoene-Wroński.

MLLE. L. STANKIEWICZ : Some formulæ of the calculus of inverses.

M. WOLFKE : The degenerate states of helium. If the two states I and II are due to degeneration, they ought to exist also in solid and gaseous helium.

M. KAMIEŃSKI : Origin of Wolf's comet (1).

S. PIOTROWSKI : Graphical method for finding pairs of stars of which the geographic latitude is determined by the method of corresponding heights.

J. CHOJNACKI : Modifications of biacene ($C_{24}H_{16}$). Two forms, α and β, are obtained by crystallization of solutions in benzene below and above 100° C. respectively. Crystallographic data are given.

M. CENTNERSZWER and A. WOLDENBERG : Presumed disaggregation of metals in liquids under the influence of ultra-violet light. Colloidal solutions in water of iron, lead, silver and mercury are formed, due to the production of ozone which acts as an oxidizing agent.

MLLE. R. LUDWICZAK and J. SUSZKO : (1) Dibrom derivatives of quinidines and their transformation into natural bases. (2) Vinyl-phenol bases of quinidine : cupreine and cupreidine.

K. KONIOR : Geological structure of the neighbourhood of Strzyżów.

A. BURSA, MME. H. WOJTUSIAK and R. J. WOJTUSIAK : Researches on the submarine fauna and flora of the Bay of Gdańsk, Baltic Sea, carried out with the aid of a diving apparatus.

J. BORYSOWICZ : Comparative researches on the cyto-architecture of the corpus geniculatum externum.

Moscow

Academy of Sciences (*C.R.*, **20**, No. 9, 1938).

V. S. FEDOROFF : Polynomes of a complex variable.

A. G. DANOW : Splitting of nuclei by cosmic rays at high altitudes, according to observations made with the help of photoplates with a thick layer.

L. I. ROUSSINOW and A. A. YUSEPHOVICH : Soft radiation from bromine.

R. V. TELESNIN : Rate of variation of iron magnetization at different sections of the hysteresis loop.

P. A. CHERENKOV : Spectrum of visible radiation produced by fast electrons.

S. S. SHALYT : Anomalous magnetic properties of anhydrous $FeCl_3$.

I. KHVOSTIKOV and N. ERSHOVA : Instability of the ozone layer at sunrise and sunset and the problem of determination of the height of the ozone layer.

N. A. TOROPOW and P. F. KONOVALOW : Solid solutions of the orthosilicates of barium and calcium.

I. I. KORNILOV and V. S. MIKHEJEV : Aluminometric method of producing chrome-aluminium alloys.

W. A. ISMAILSKI and E. A. SMIRNOV : (1) Coloration of the arylamides of the *p*-nitro-phenylacetic acid. (2) The coloration of the arylamides of the *p*-nitro-hydrocynnamic acid.

M. K. DJAKOVA, A. V. LEZOVOJ, T. G. STEPANZEVA and S. A. SENJAVIN : Solution of coals.

B. V. IVANOV, A. I. ZVETKOV and I. M. SHUMILO : Egyptian blue and refractories for copper smelting furnaces.

A. F. KALINKEVICH : Effect of nitrogen-potassium periodic supply upon yield of root and store of rubber in 'kok-saghyz'.

G. M. LITVER : (1) Susceptibility of the sporogony process in oocysts of Coccidia to ultra-violet rays as dependent upon temperature conditions and the separative power of oocysts. (2) The significance of aerobic and anaerobic conditions for the effect of ultra-violet rays on processes of sporogony of Coccidia from rabbit.

M. SAVCHUK : The gradient-field (in regeneration).

N. I. SHAPIRO : Time and spontaneous mutation in *Drosophila melanogaster*.

V. P. ZOSSIMOVICH : Interspecific hybridization in *Beta*. (1) Experimental synthesis and the origin of *Beta trigyna* W. and K. ($2n = 54$).

N. E. ZAIKOVSKAJA: Reduction division in interspecific hybrids in the genus *Beta*.

P. V. MIKHAILOVA: Inheritance of yellow leaf colour in *Nicotiana tabacum* L.

N. D. TARNAVSKY: Role of nucleinic acid in chromosome conjugation.

N. A. KASHPOROV: Nitrogen supply to sunflower according to development periods.

G. M. PSAREV: Effect of day length upon growth of stem parenchyma cells in soya.

M. I. GOLDIN: (1) Tobacco mosaic virus as influenced by micro-organisms. (2) Adsorption of tobacco mosaic virus by micro-organisms.

P. A. NESTERENKO and S. N. ZARITSKY: 'Hollowness' in Clary sage (*Salvia sclarea* L.).

K. S. SOUKHOV and A. M. VOVK: Mosaic of cultivated cereals and its transmission in Nature.

S. A. IVANOVA: Influence of excessive parathyroid hormone on the development of bones.

A. W. RUMJANTSEW and L. F. BEREZKINA: Inductive action of cartilage *in vitro*.

Rome

National Academy of the Lincei (*Atti*, 28, 217–272, 1938).

Q. MAJORANA: Comparison between thermal theory and experiments in metallic photo-resistance.

G. CHECCHIA-RISPOLI: Observations on the structure of the shell of Clypeasters.

E. BORTO LOTTI: Differential projective geometry of dualistic transformations.

R. CALAPSO: Deformation of the Voss lattices of a Euclidean S_4.

C. MIRANDA: A problem of differential geometry set by Minkowski.

U. SALINI: Applications of Minding's method for the deformation of ruled surfaces.

A. TONOLO: Extension of a trigonometrical theorem of Legendre.

M. VILLA: Quasi-asymptotic curves (1).

G. COLONNETTI: Investigation of the experimental foundations of the theory of elasto-plastic equilibrium.

G. B. BONINO and R. MANZONI-ANSIDEI: Raman spectrum of ortho-deuteroxybenzaldehyde.

G. GOIDÀNICH: Influence of the stock on the receptivity of the graft towards parasitic infections.

V. ZAGAMI: Researches on the seminal fluid (8). *p*H value of the seminal fluid of the rabbit.

Forthcoming Events

[*Meeting marked with an asterisk is open to the public.*]

Monday, May 1

ROYAL GEOGRAPHICAL SOCIETY, at 5.30.—A. M. Champion: "By Motor Van from Cape Verde to Nairobi" (Film).

Tuesday, May 2

UNIVERSITY COLLEGE, LONDON, at 5.—Prof. E. J. Bigwood: "Chemical Reactions between Proteins and Electrolytes".*

ST. MARY'S HOSPITAL, LONDON, W.2, at 5.—Dr. Wilson Smith: "The Prevention and Control of Virus Diseases".

INSTITUTION OF CIVIL ENGINEERS.—Prof. Karl von Terzaghi: "Soil Mechanics: A New Chapter in Engineering Science" (James Forrest Lecture).

Thursday, May 4

UNIVERSITY OF CAMBRIDGE (CAVENDISH LABORATORY), at 4.30.—Prof. P. M. S. Blackett, F.R.S.: "Cosmic Rays: New Results and Further Problems" (Scott Lectures. Succeeding lectures on May 5 and 8).

PHYSICAL, CHEMICAL AND ROYAL METEOROLOGICAL SOCIETIES (at the Royal Institution), at 5.30.—Discussion on "Chemical and Physical Investigations of the Upper Atmosphere" to be opened by Prof. F. A. Paneth.

Friday, May 5

ROYAL INSTITUTION, at 9.—Prof. W. L. Bragg, F.R.S.: "Magnets".

IRON AND STEEL INSTITUTE, May 3–5. Annual meeting to be held at the Institution of Civil Engineers.

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

SCIENTIFIC OFFICERS, JUNIOR SCIENTIFIC OFFICERS AND ASSISTANTS (grade II) in the Chemical Defence Research Establishment, Sutton Oak, or the Chemical Defence Experimental Station, Porton—Chief Superintendent, C.D.R.D., 14 Grosvenor Gardens, London, S.W.1 (May 5).

ASSISTANT CHEMIST for the London Shellac Research Bureau—The High Commissioner for India, General Department, India House, Aldwych, W.C.2 (May 6).

SENIOR RESEARCH OFFICER (grade II) to take charge of the Poultry Disease Laboratory, Edinburgh and RESEARCH OFFICERS for work in parasitology in the Veterinary Laboratory, Weybridge—The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, London, S.W.1 (May 8).

PROFESSOR OF GEOGRAPHY in an Art College for Girls to be opened in Calcutta—The High Commissioner for India, General Department, India House, Aldwych, London, W.C.2 (May 13. Quote 3/044A).

JUNIOR SCIENTIFIC OFFICER in the Chemical Research Laboratory, Teddington, Middlesex—The Establishment Officer, Department of Scientific and Industrial Research, 16 Old Queen Street, Westminster, S.W.1 (ref. *J* 30/6. May 16).

SENIOR LECTURER IN THE ZOOLOGY OF VERTEBRATES and JUNIOR LECTURER IN THE ZOOLOGY OF INVERTEBRATES in the University of Edinburgh—The Secretary (May 22).

EIGHT CHEMISTS in Admiralty Cordite Factories—Secretary of the Admiralty (C.E. Branch II), London, S.W.1.

Reports and other Publications

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

Transactions of the Royal Society of Edinburgh, Vol. 59. Part 3, No. 25: Differential Fertility in Scotland, Part 2. By Dr. Enid Charles. Pp. 673–686. (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) 1*s*. 9*d*. [295]

Rhodesia—Nyasaland Royal Commission. Report. (Cmd. 5949.) Pp. x+283. (London: H.M. Stationery Office.) 7*s*. 6*d*. net. [303]

This Cruelty called Sport! By Air Commodore L. E. O. Charlton. Second edition. Pp. 48. (London: League for Prohibition of Cruel Sports.) 6*d*. [311]

Other Countries

Indian Association for the Cultivation of Science. Special Publication No. 6: Garnets and their Role in Nature. Based on Lectures delivered by Sir Lewis Leigh Fermor. Pp. v+105. (Calcutta: Indian Association for the Cultivation of Science.) 2.8 rupees; 4*s*. net. [273]

Ministério de Educação e Saúde. Anuário publicado pelo Observatório Nacional do Rio de Janeiro para o ano de 1939. (Ano 55.) Pp. xiii+492. (Rio de Janeiro: Observatório Nacional.) [283]

Le fonds national de la recherche scientifique et l'industrie. Par P. Beghin. Pp. ix+408. (Bruxelles: Fonds National de la Recherche scientifique.) [290]

Outline of the History of Mathematics. By Raymond Clare Archibald. Fourth edition, revised and enlarged. Pp. ii+66. (Oberlin, Ohio: Mathematical Association of America, Inc.) 50 cents. [303]

New Zealand: Department of Scientific and Industrial Research. Bulletin No. 69: Scientific and Industrial Research, 1927–1938. Pp. vii+113. 2*s*. 6*d*. Meteorological Office Note No. 22: The Cyclonic Storms in Northern New Zealand on the 2nd February and the 29th March 1936. By Dr. M. A. F. Barnett. Pp. 34. Meteorological Observations for 1937. Pp. 33. (Wellington: Government Printer.) [313]